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(12) **United States Patent**
**Schmidt et al.**

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(45) **Date of Patent: Nov. 15, 2016**

(54) **LEADLESS CARDIAC PACEMAKER WITH DELIVERY AND/OR RETRIEVAL FEATURES**

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(73) Assignee: **Cardiac Pacemakers, Inc.**, St. Paul, MN (US)

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(22) Filed: **Aug. 5, 2014**

(65) **Prior Publication Data**

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(51) **Int. Cl.**

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| ***A61N 1/362*** | (2006.01) |
| ***A61N 1/372*** | (2006.01) |

(52) **U.S. Cl.**

CPC ............. ***A61N 1/3756*** (2013.01); ***A61N 1/362*** (2013.01); ***A61N 1/37205*** (2013.01)

(58) **Field of Classification Search**

CPC ........... A61N 1/3756; A61N 1/37205; A61N 1/362; A61N 2001/0578; A61N 1/0573; A61N 1/059; A61N 1/372; A61N 2001/058; A61N 1/057; A61N 1/0587; A61B 5/0215; A61B 2017/22035; A61B 17/221; A61B 5/686; A61F 2002/011; A61F 2/2427

USPC ................ 600/373; 606/128, 129, 200, 108; 607/122, 126, 127, 128; 623/1.11

See application file for complete search history.

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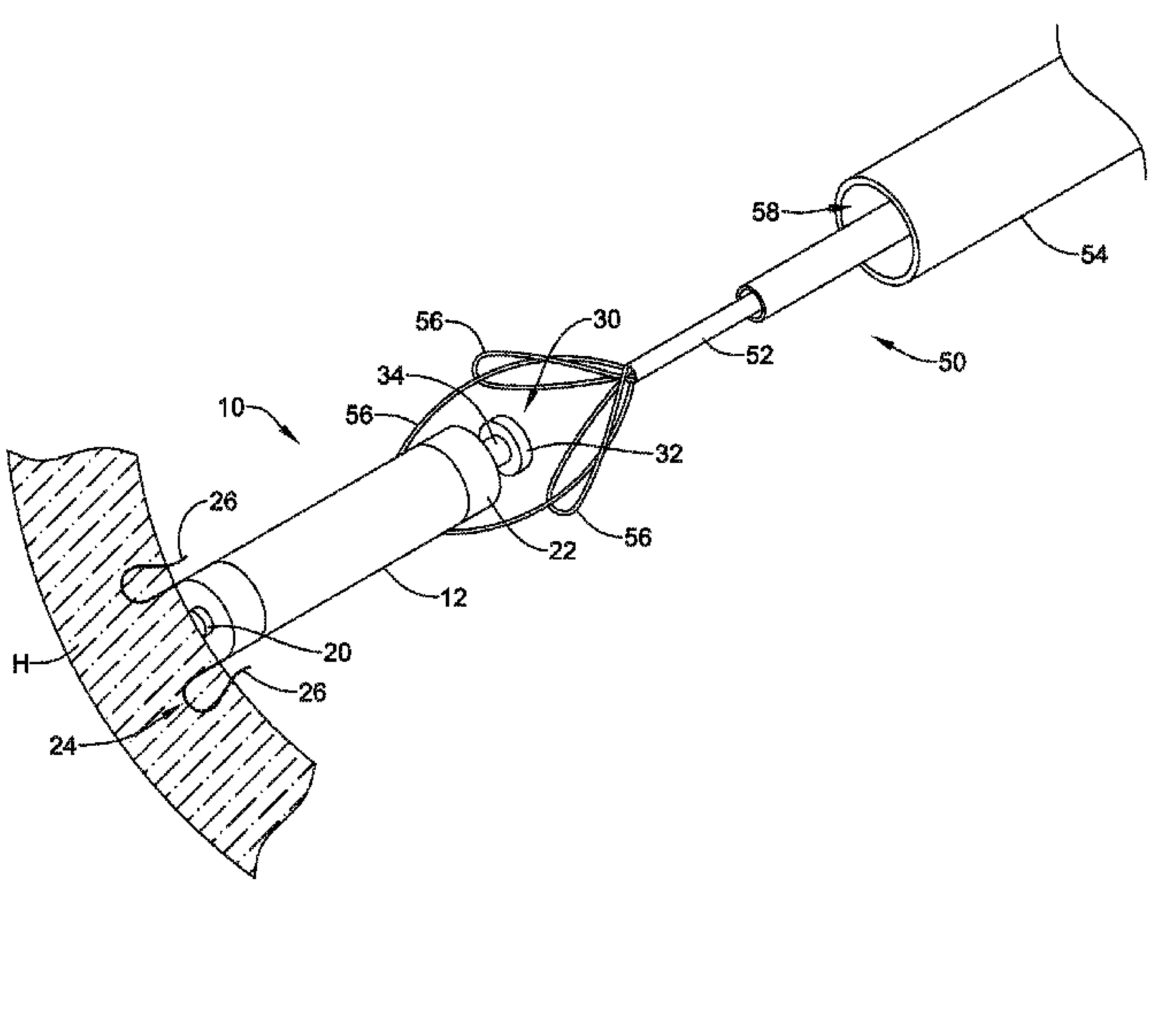
*Primary Examiner* — Katherine M Shi

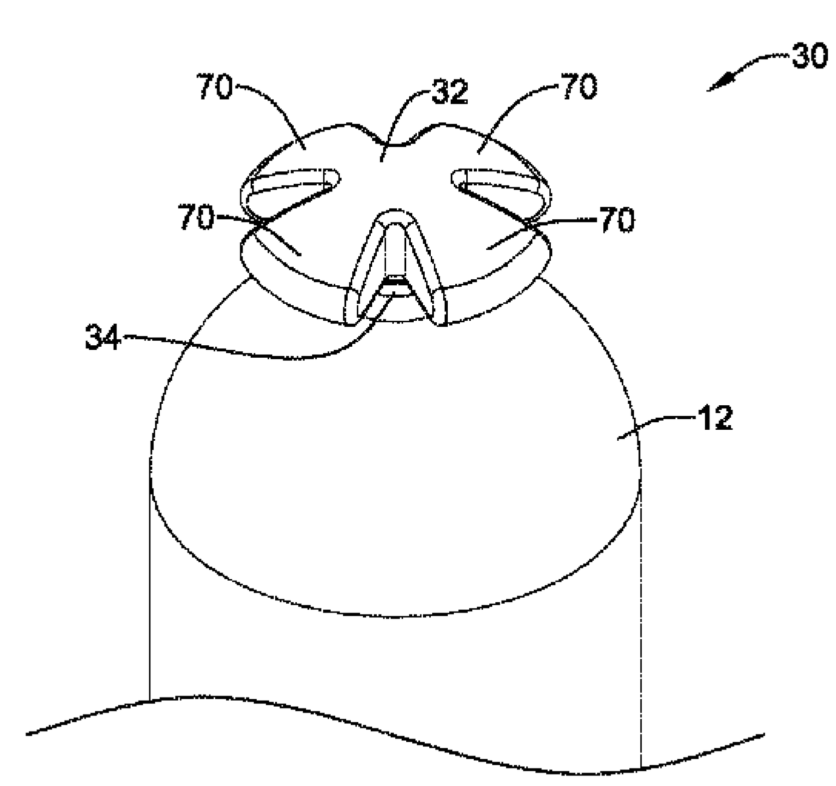
(74) *Attorney, Agent, or Firm* — Seager, Tufte & Wickhem LLP

(57) **ABSTRACT**

An implantable leadless cardiac pacing device and associated delivery and retrieval devices. The implantable device includes a docking member extending from the proximal end of the housing of the implantable device configured to engage with the delivery and/or retrieval device to facilitate delivery and/or retrieval of the implantable leadless cardiac pacing device.

**12 Claims, 49 Drawing Sheets**



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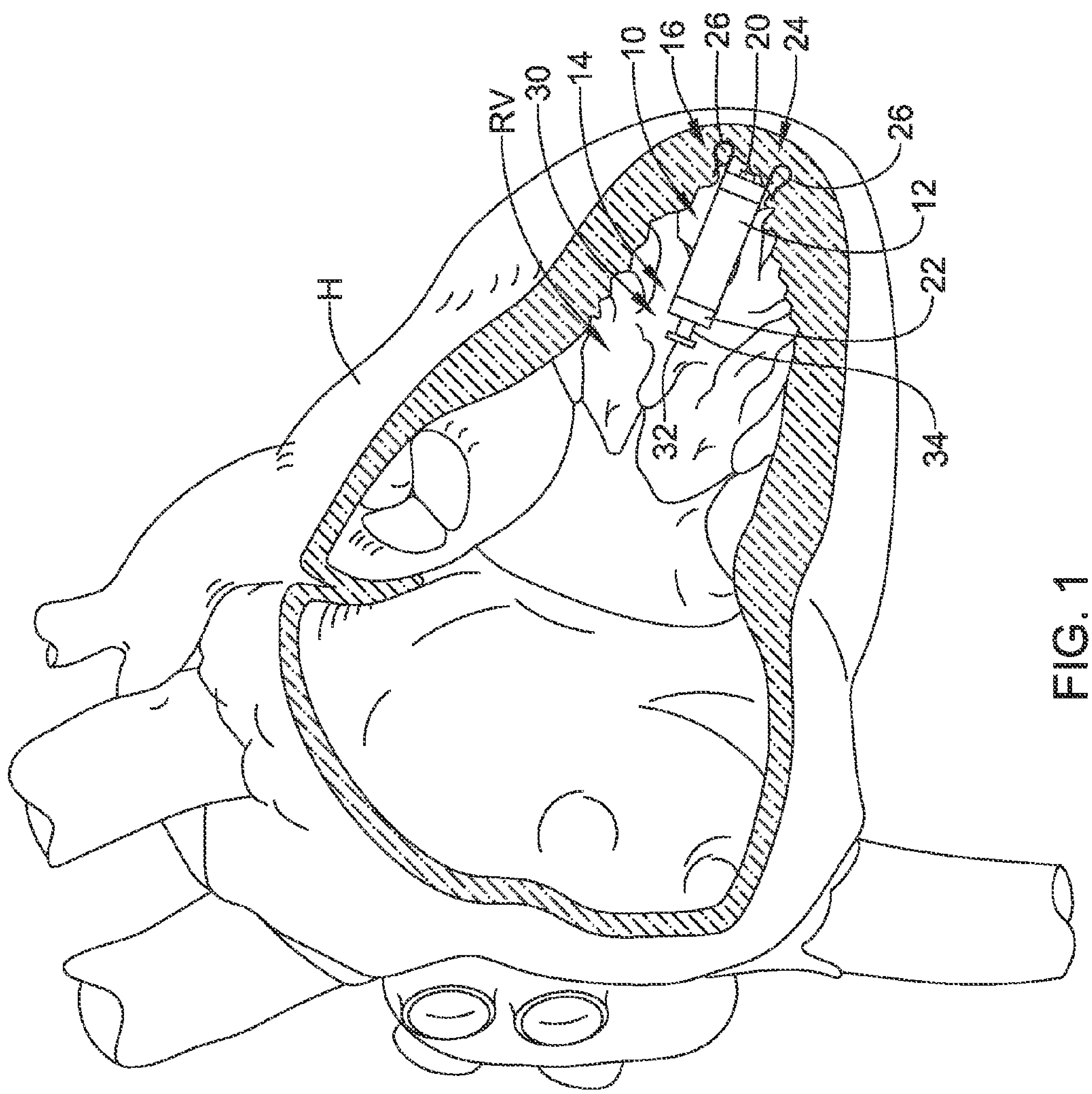


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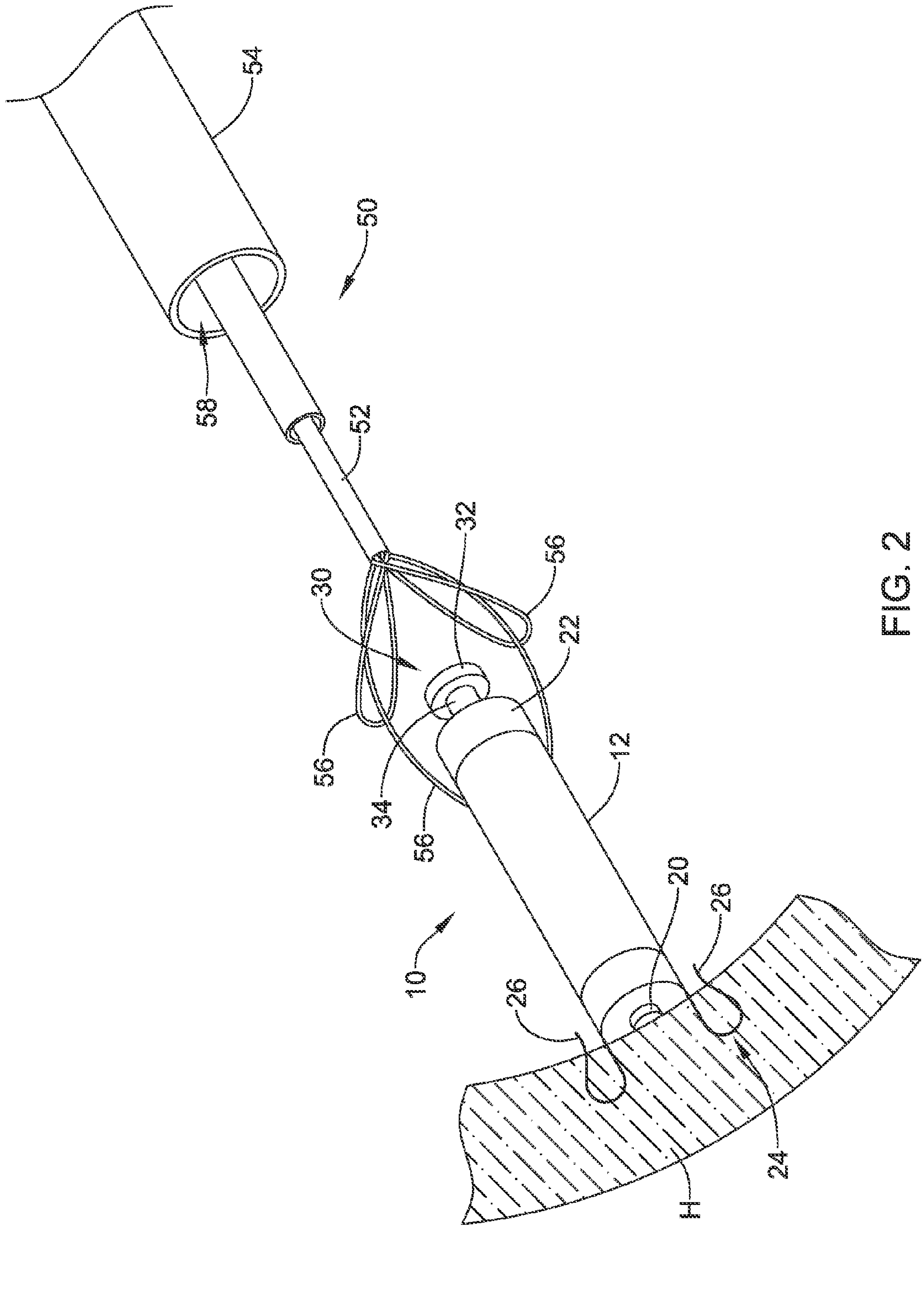


FIG. 2

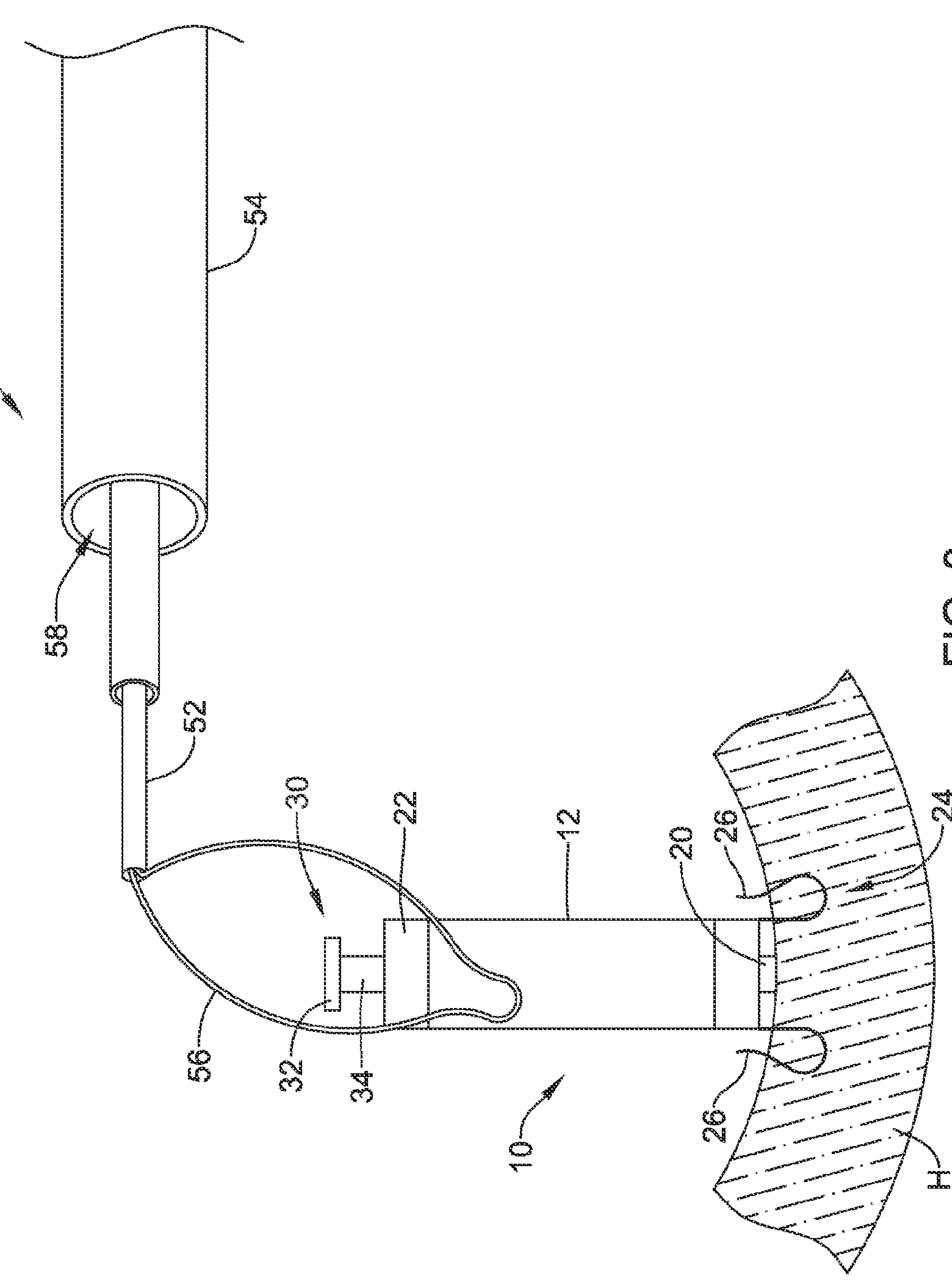


FIG. 3

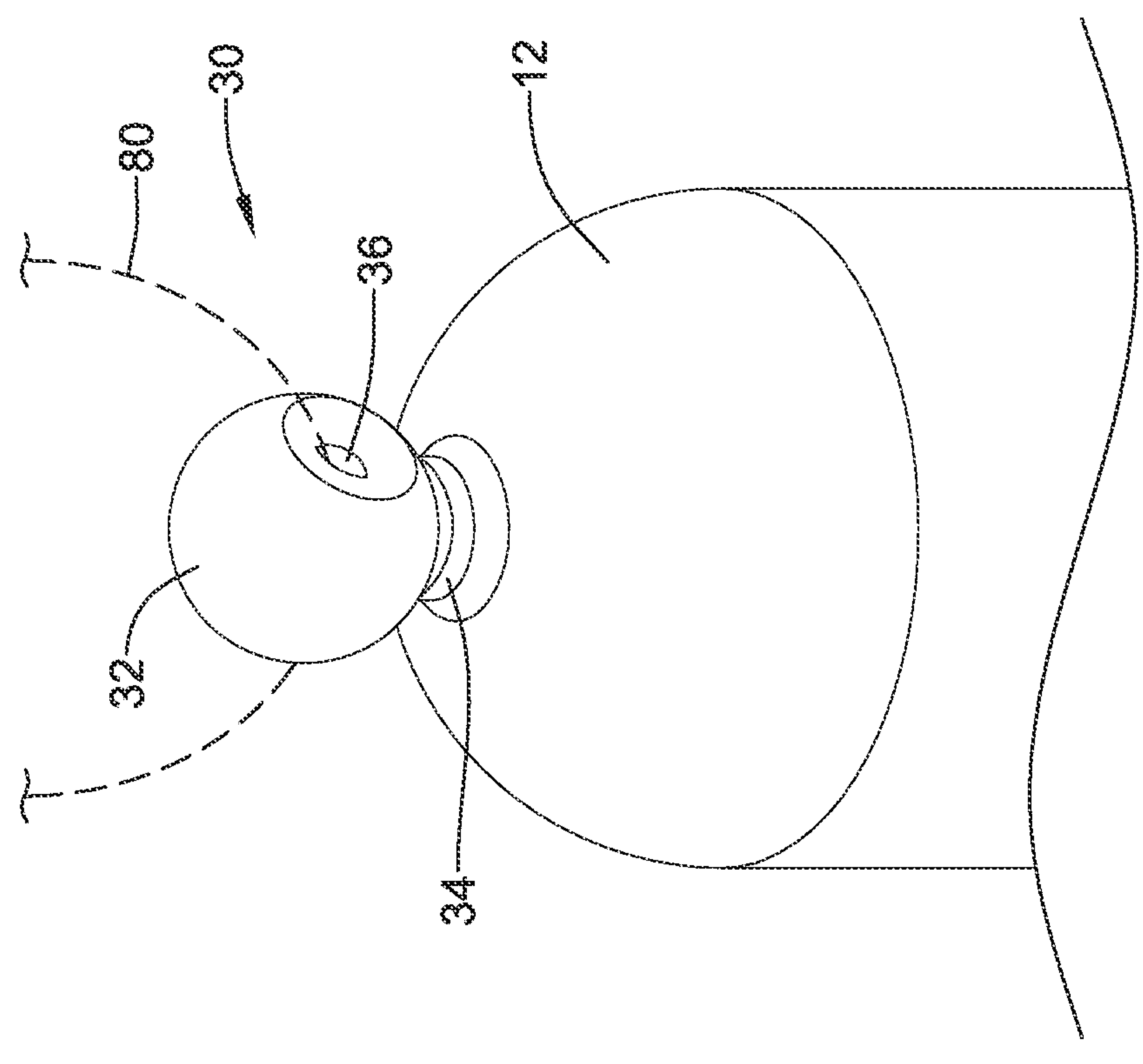


FIG. 4A

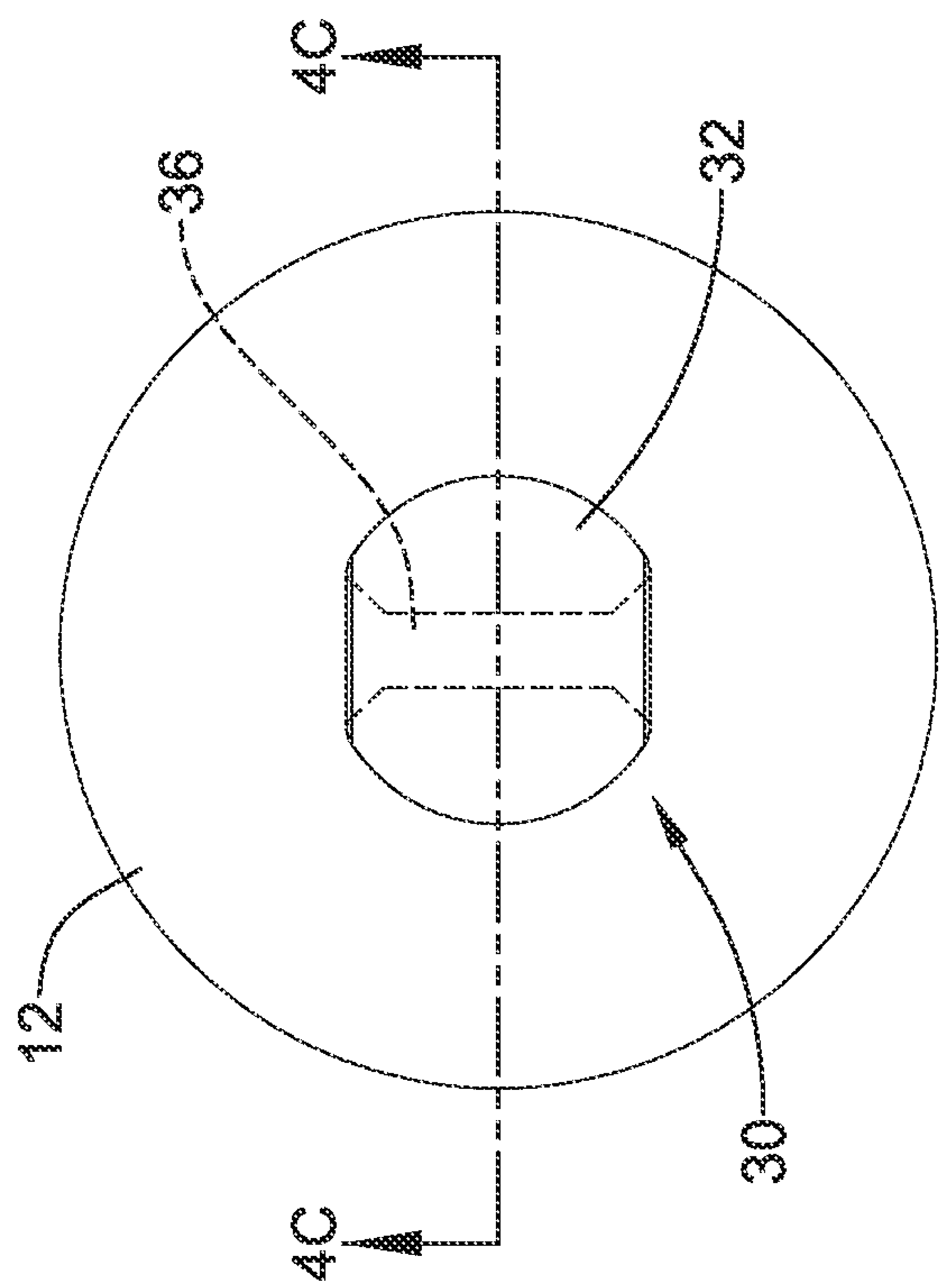


FIG. 4B

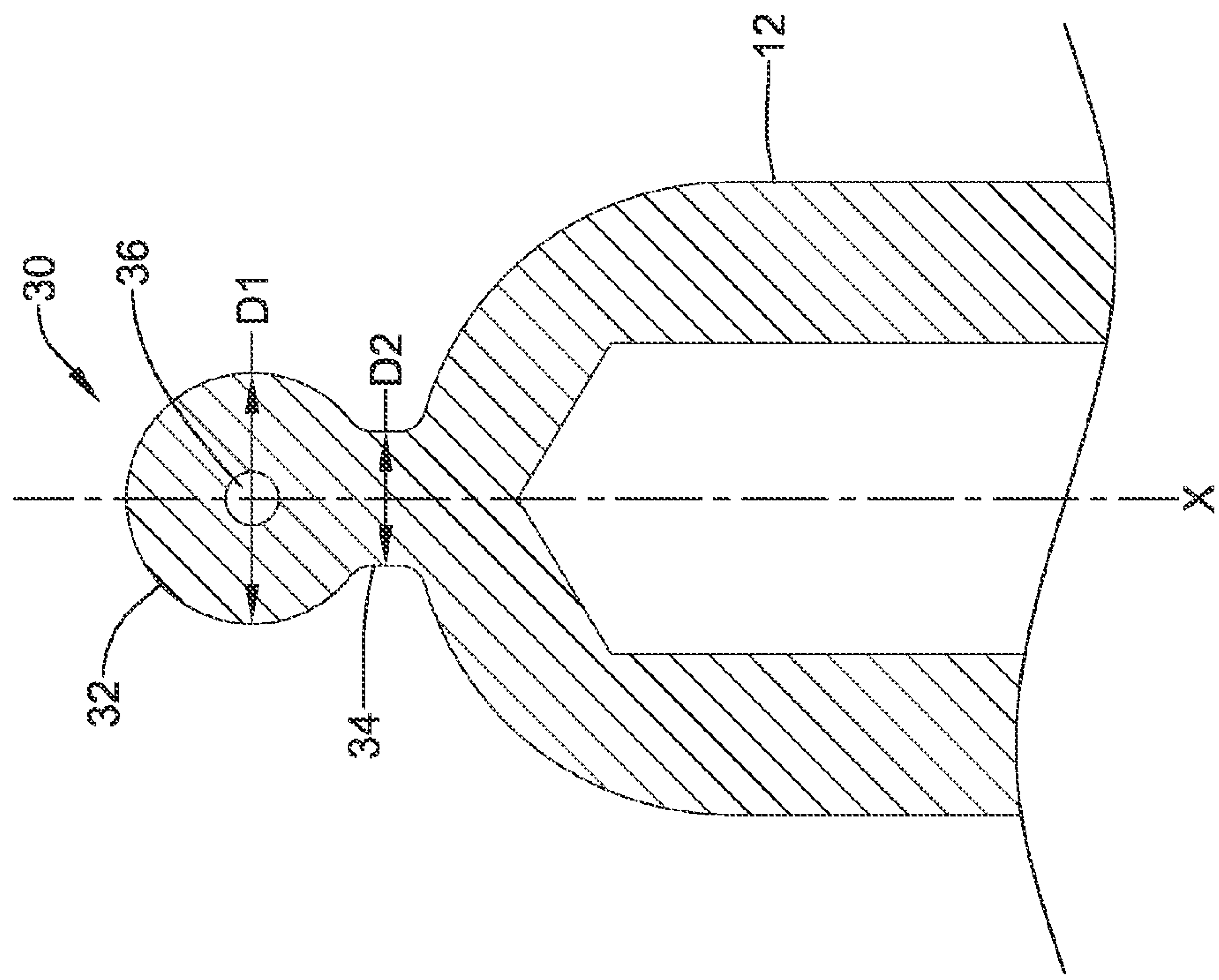


FIG. 4C

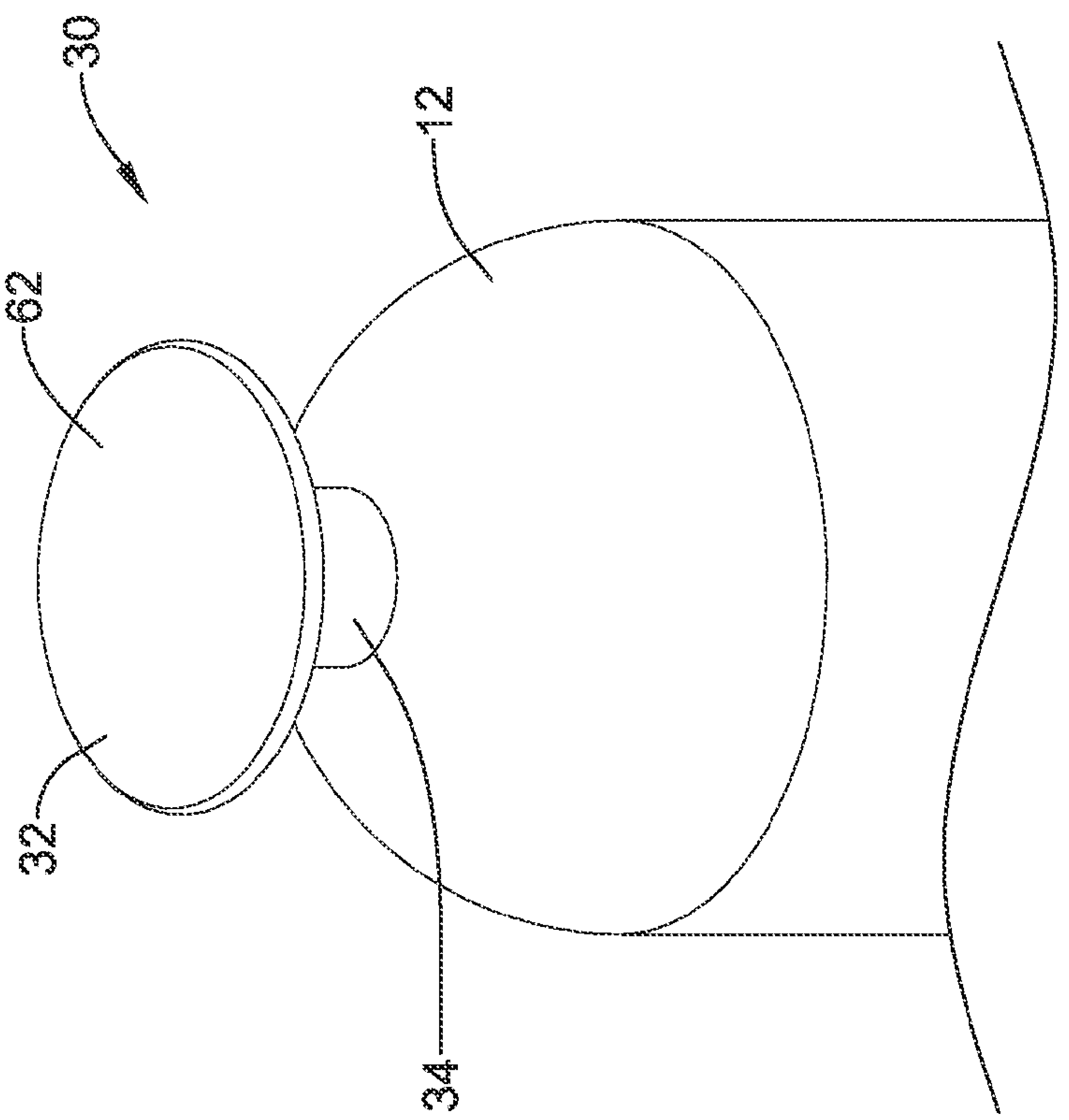


FIG. 5A

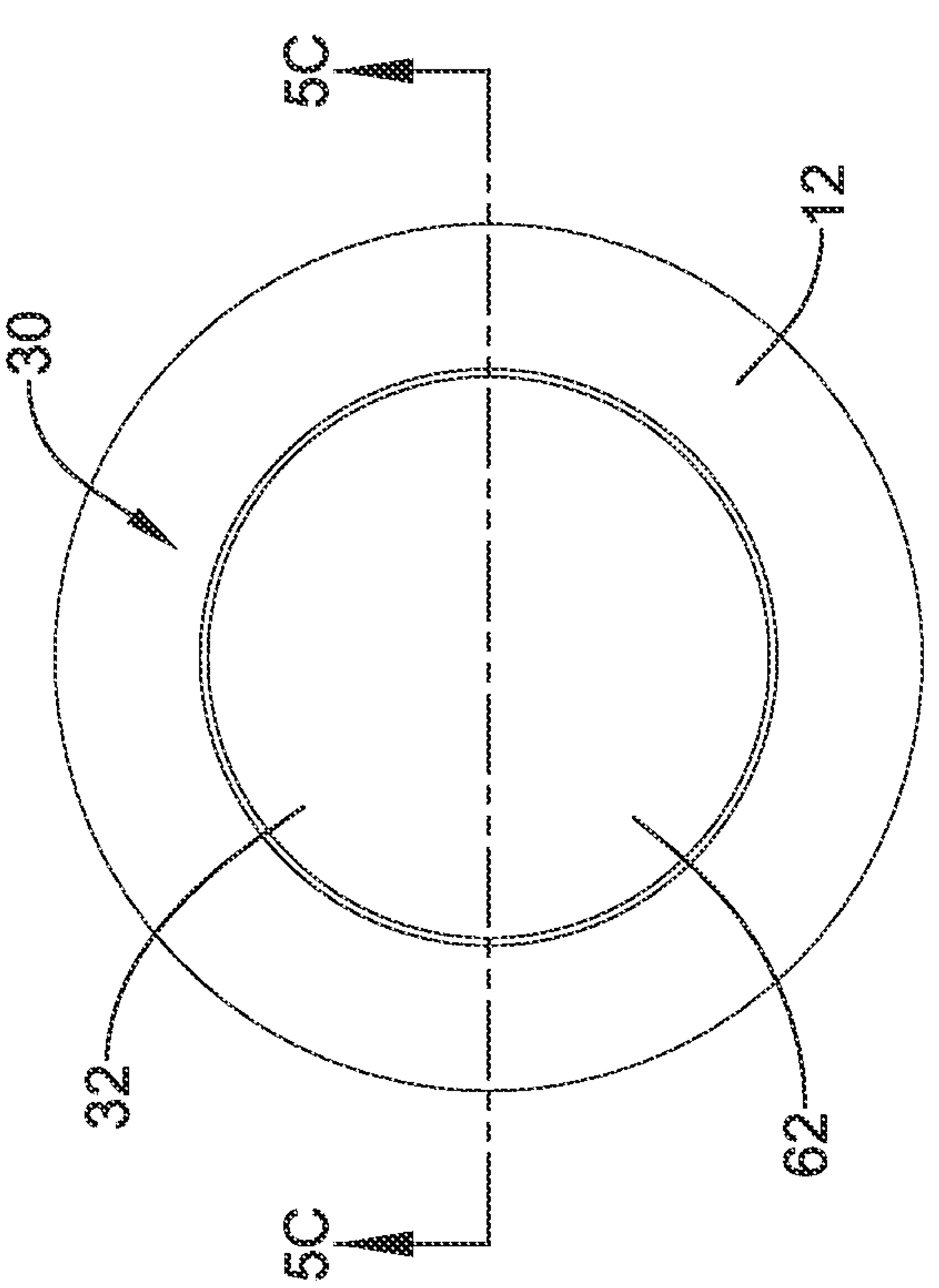


FIG. 5B

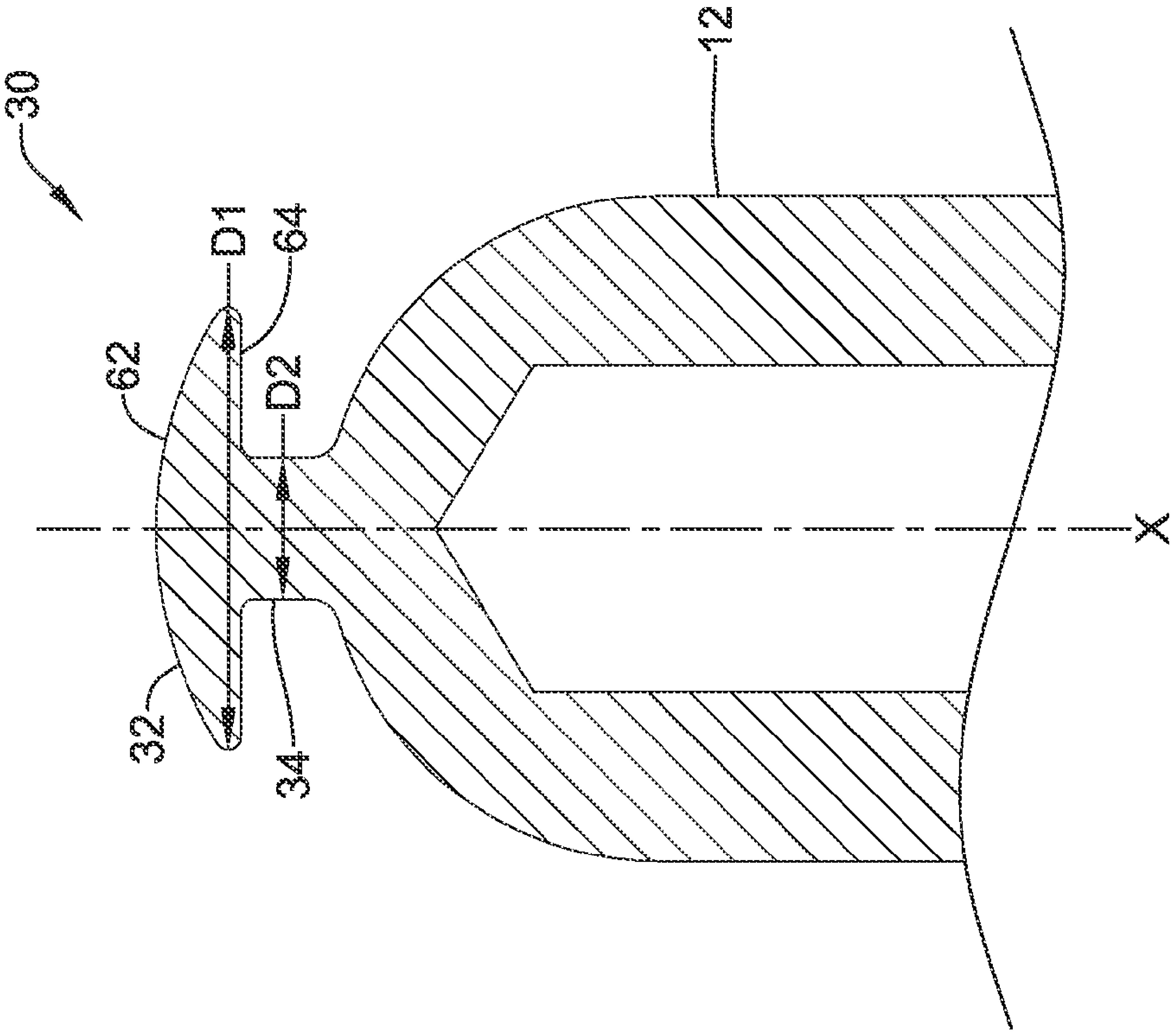


FIG. 5C

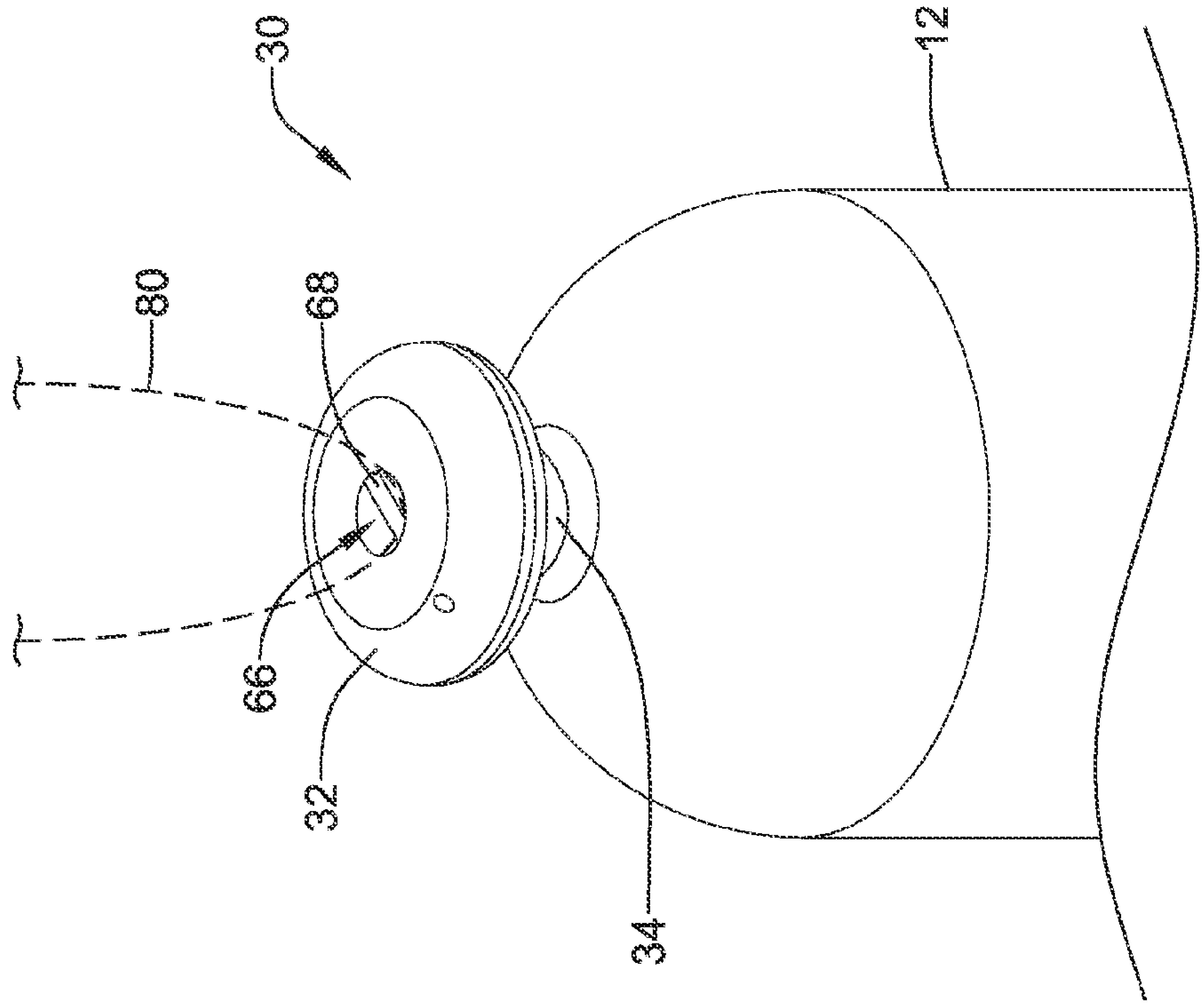


FIG. 6A

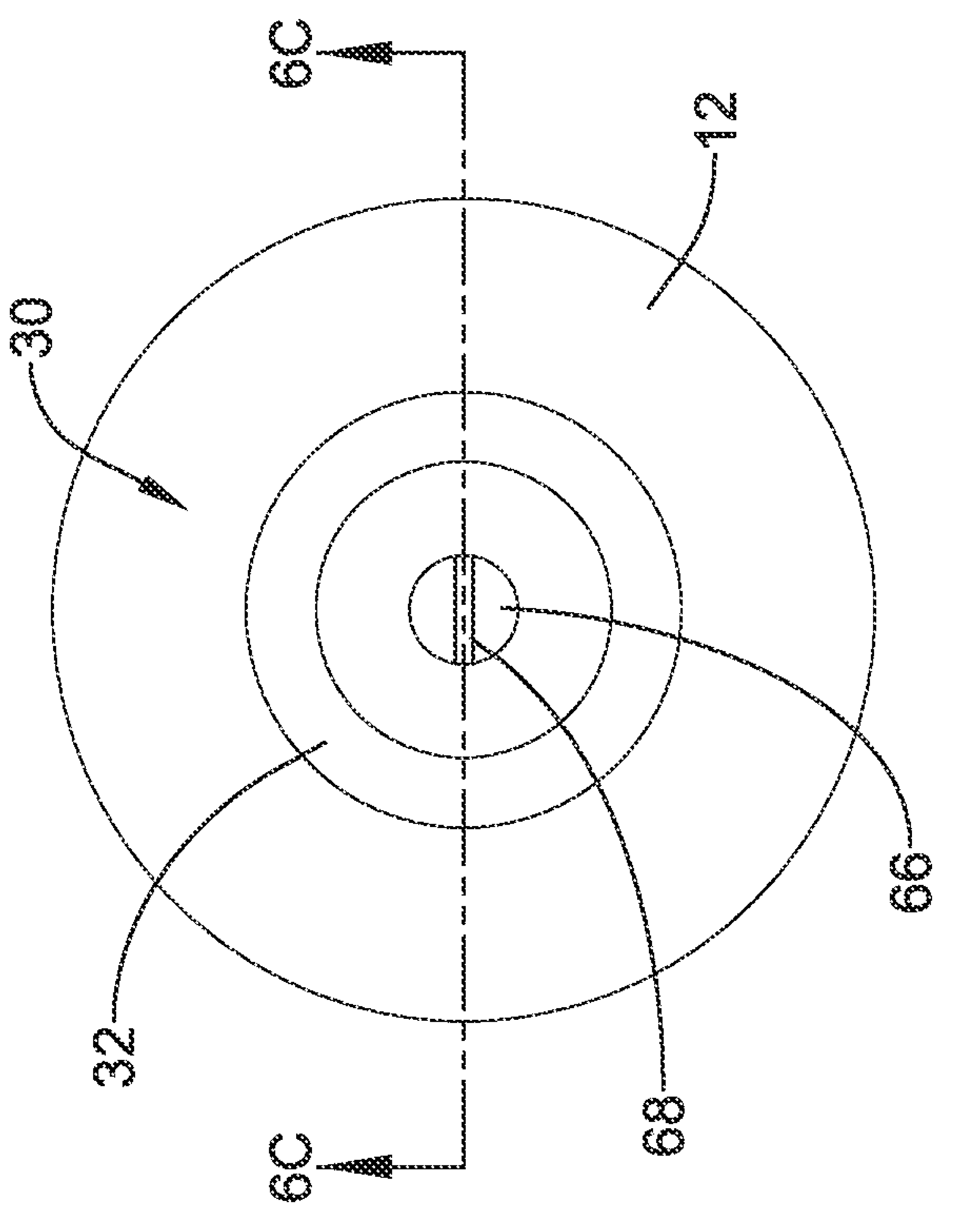


FIG. 6B

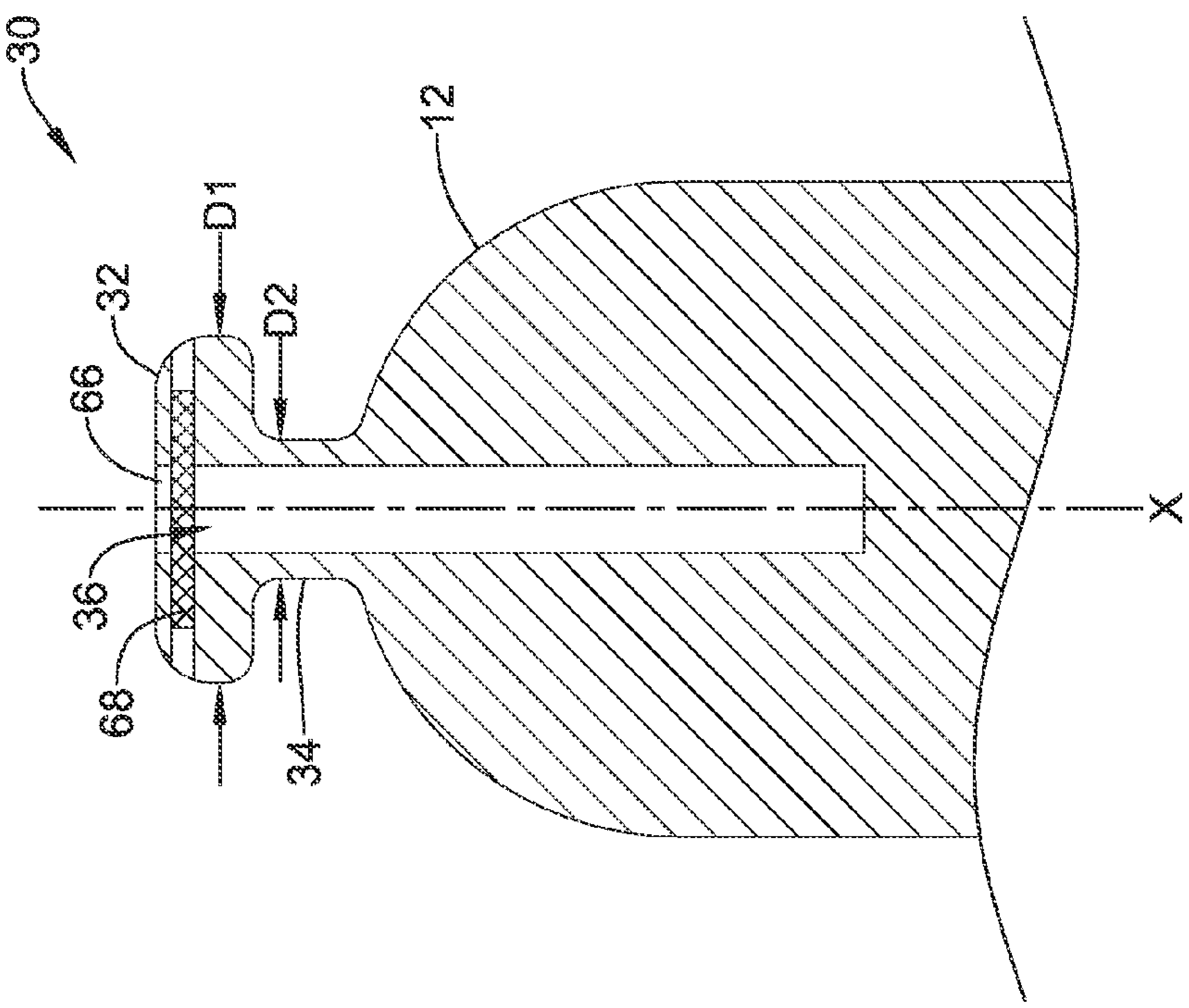


FIG. 6C

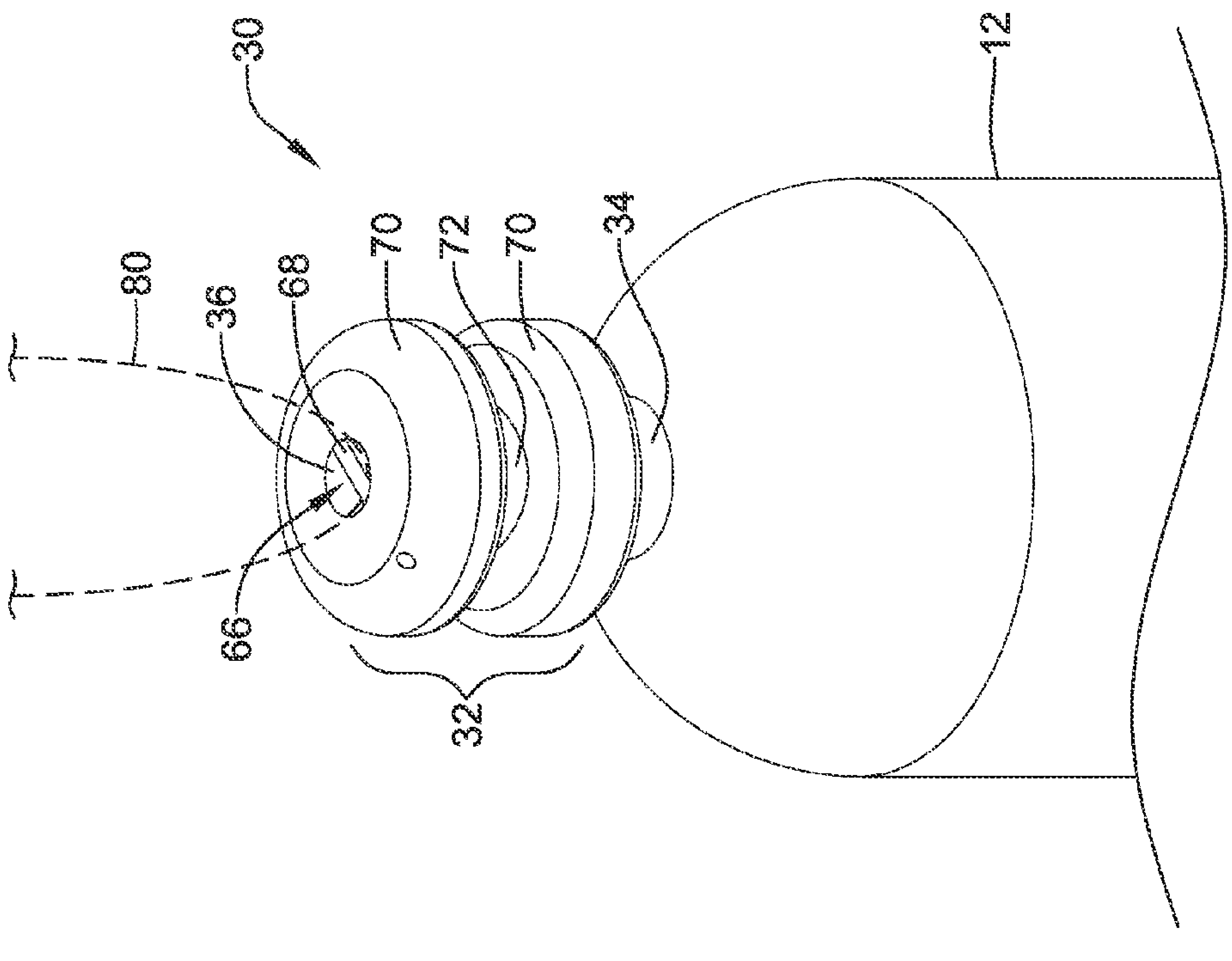


FIG. 7A

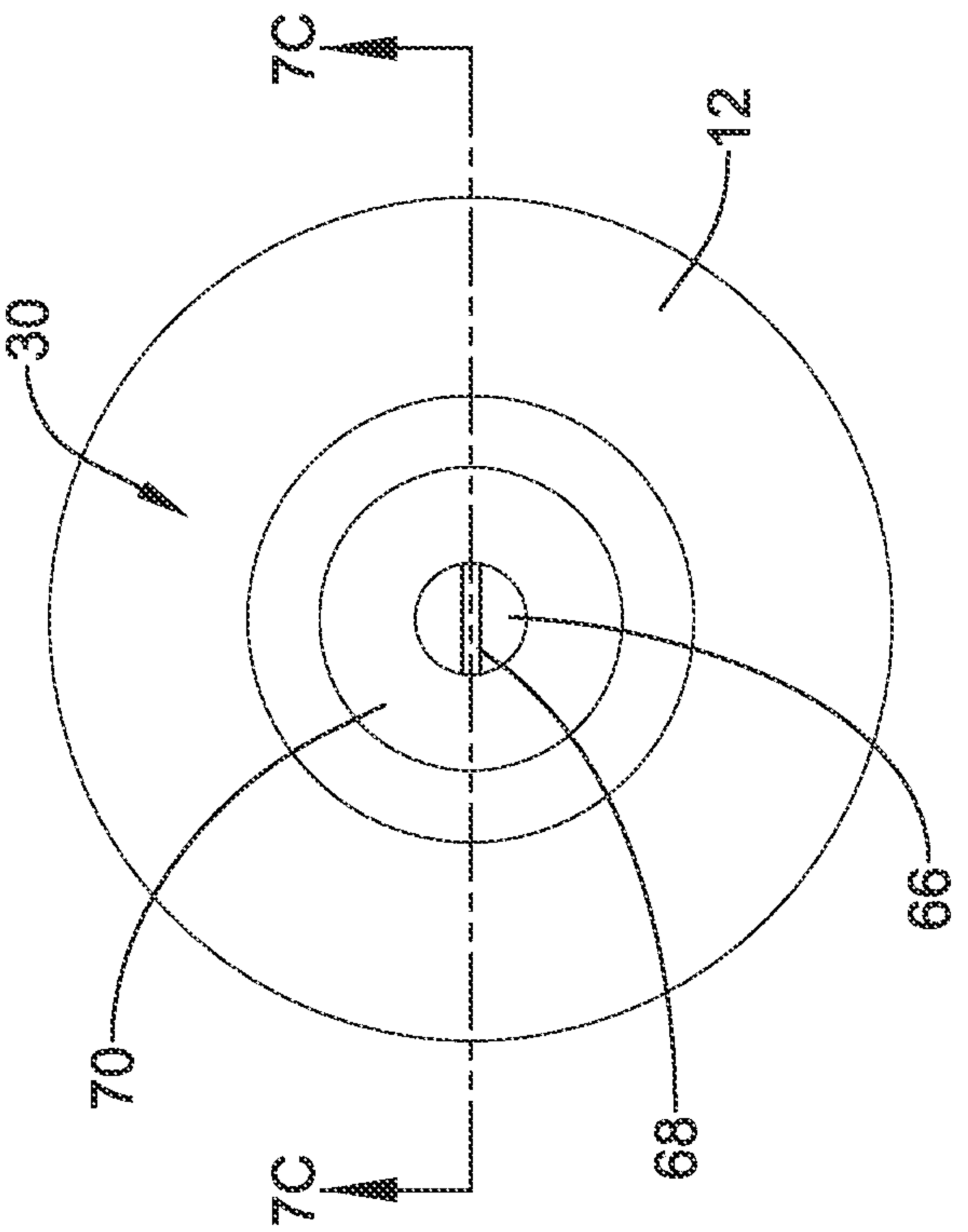


FIG. 7B

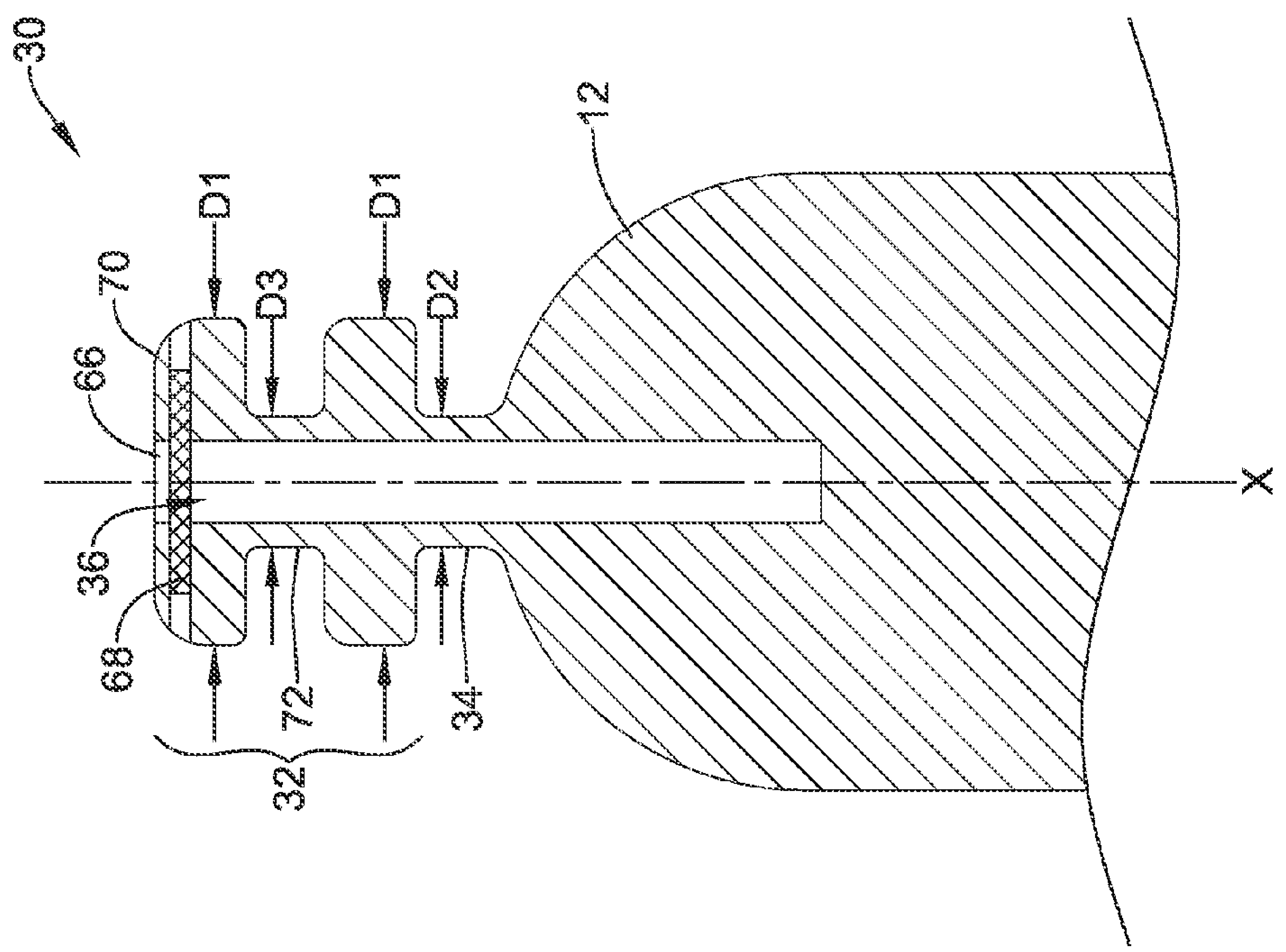


FIG. 7C

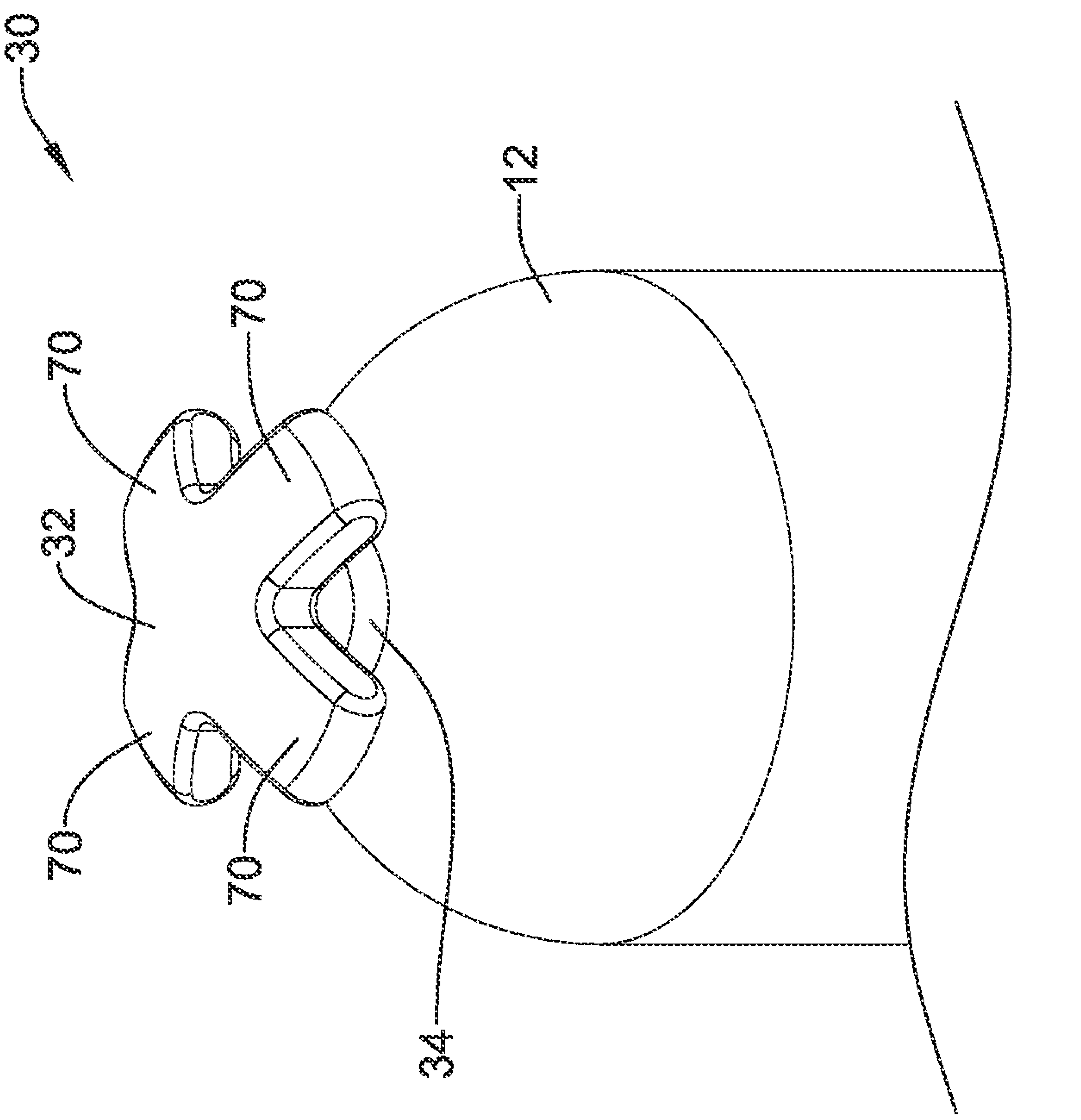


FIG. 8A

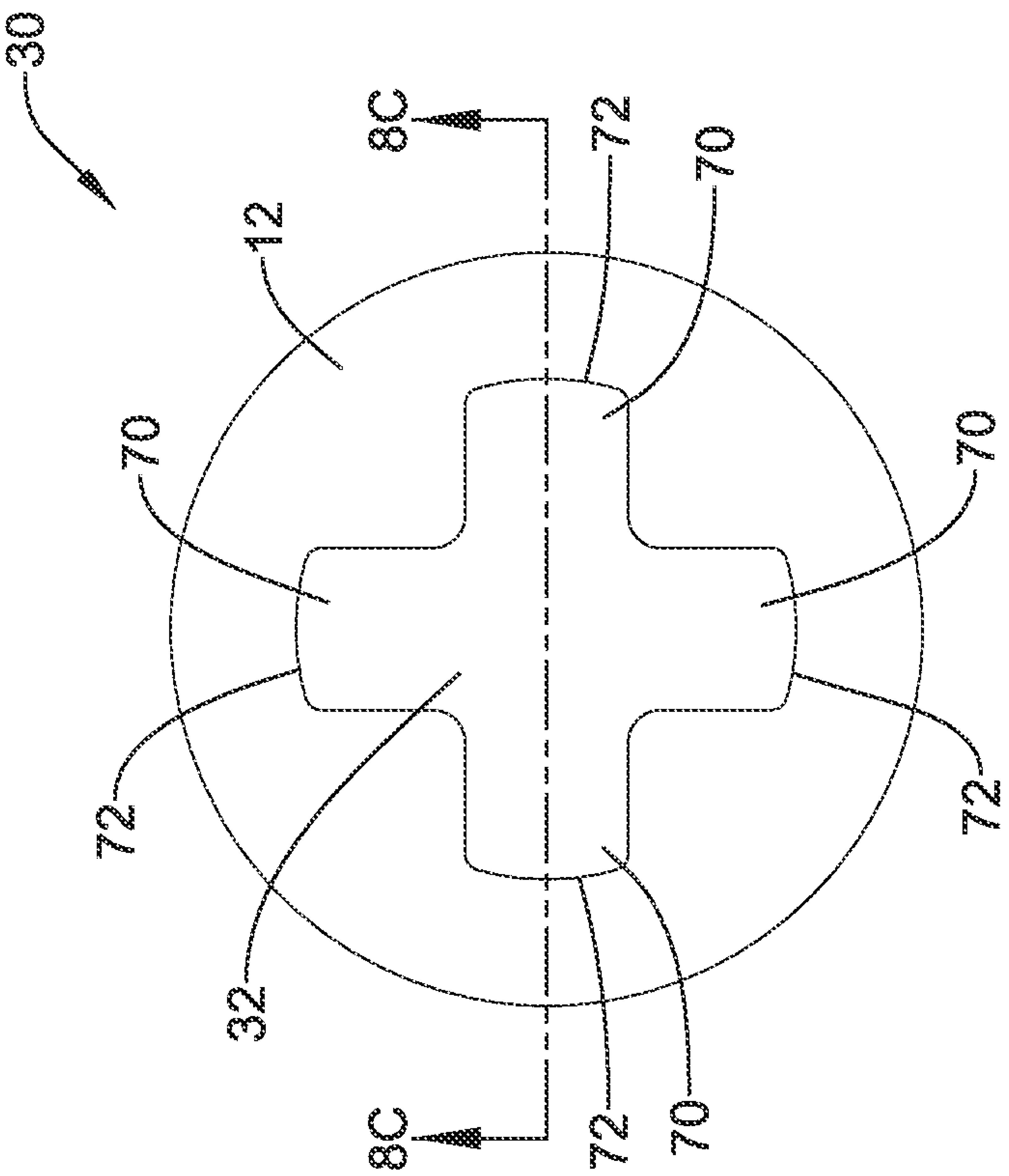


FIG. 8B

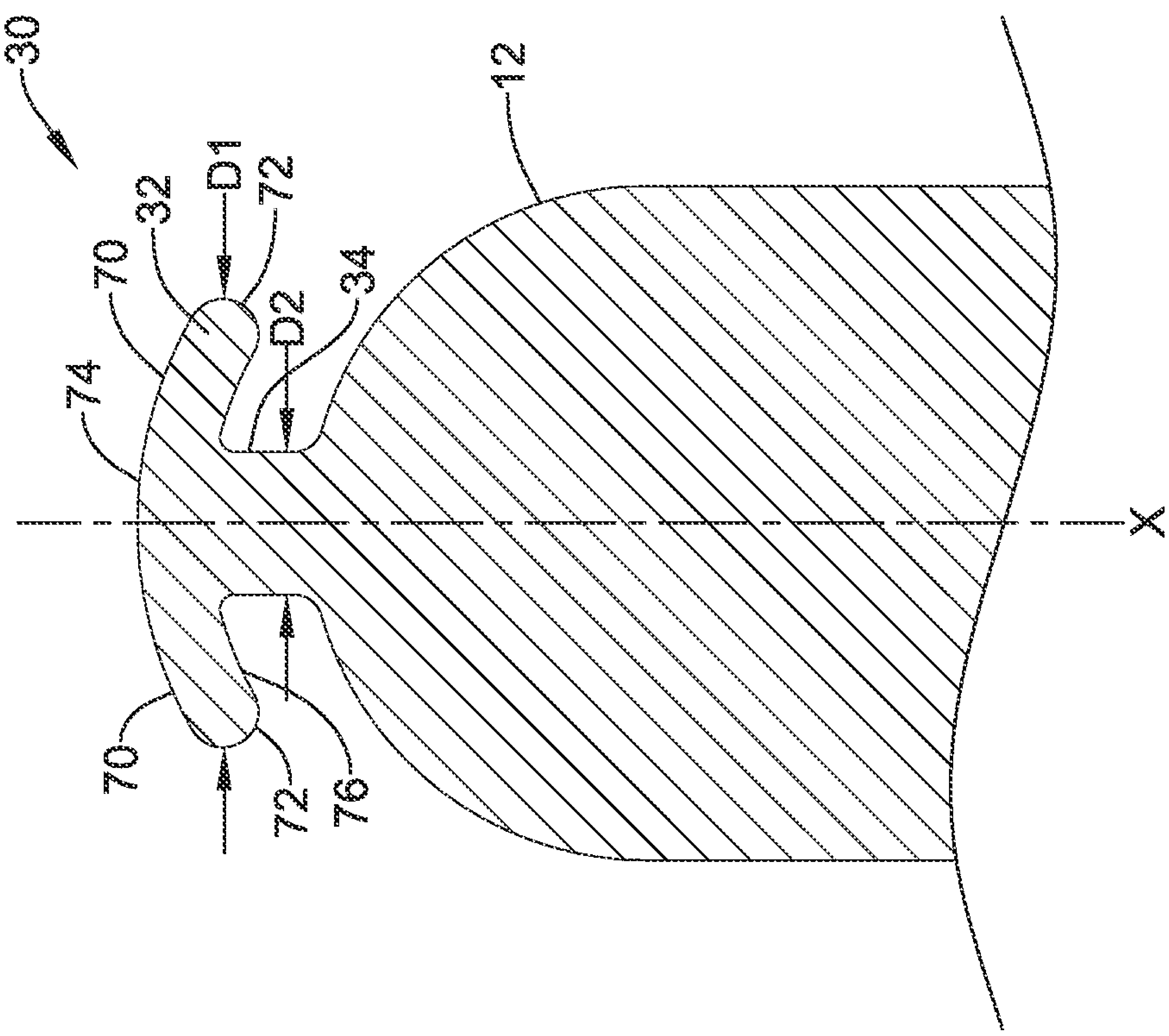


FIG. 8C

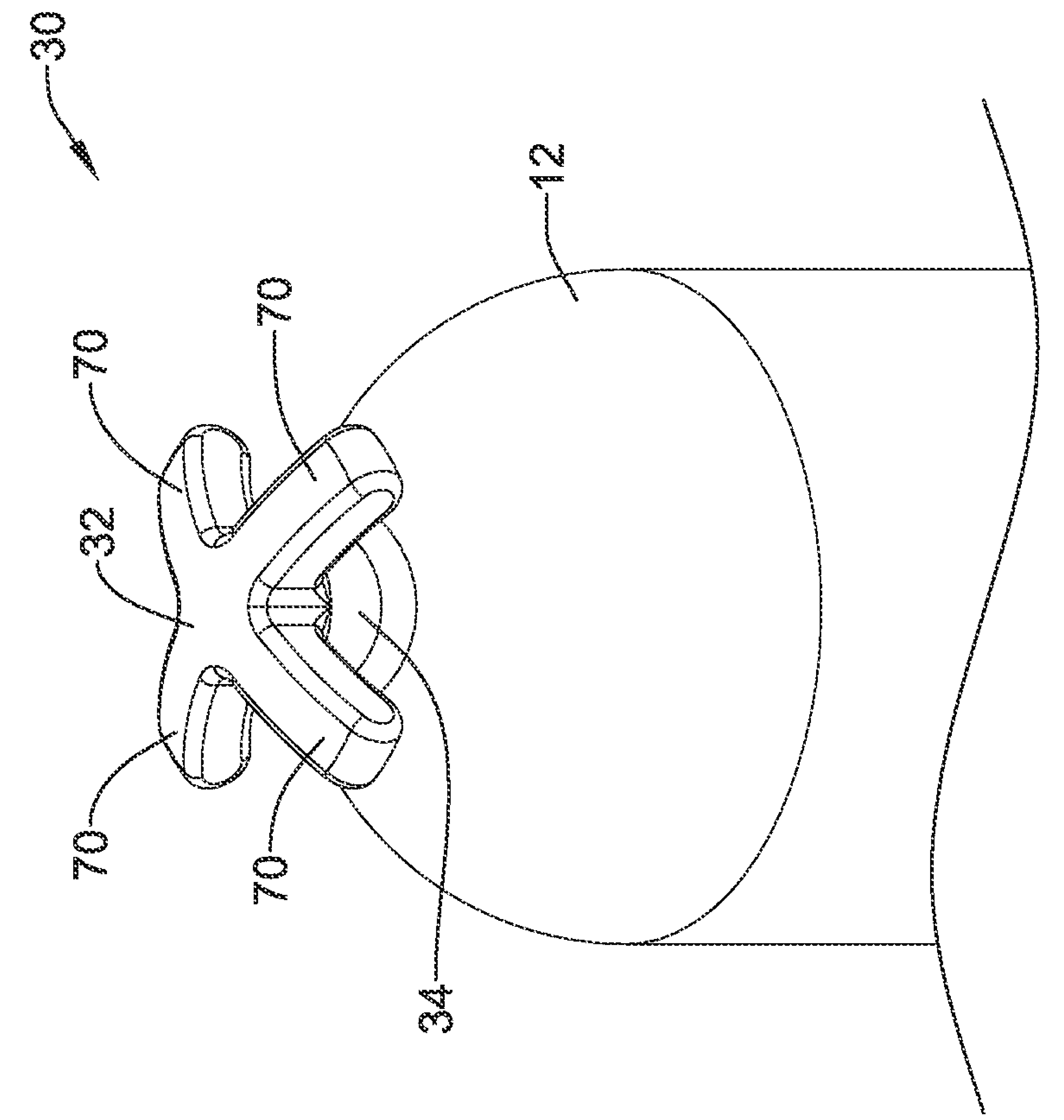


FIG. 9A

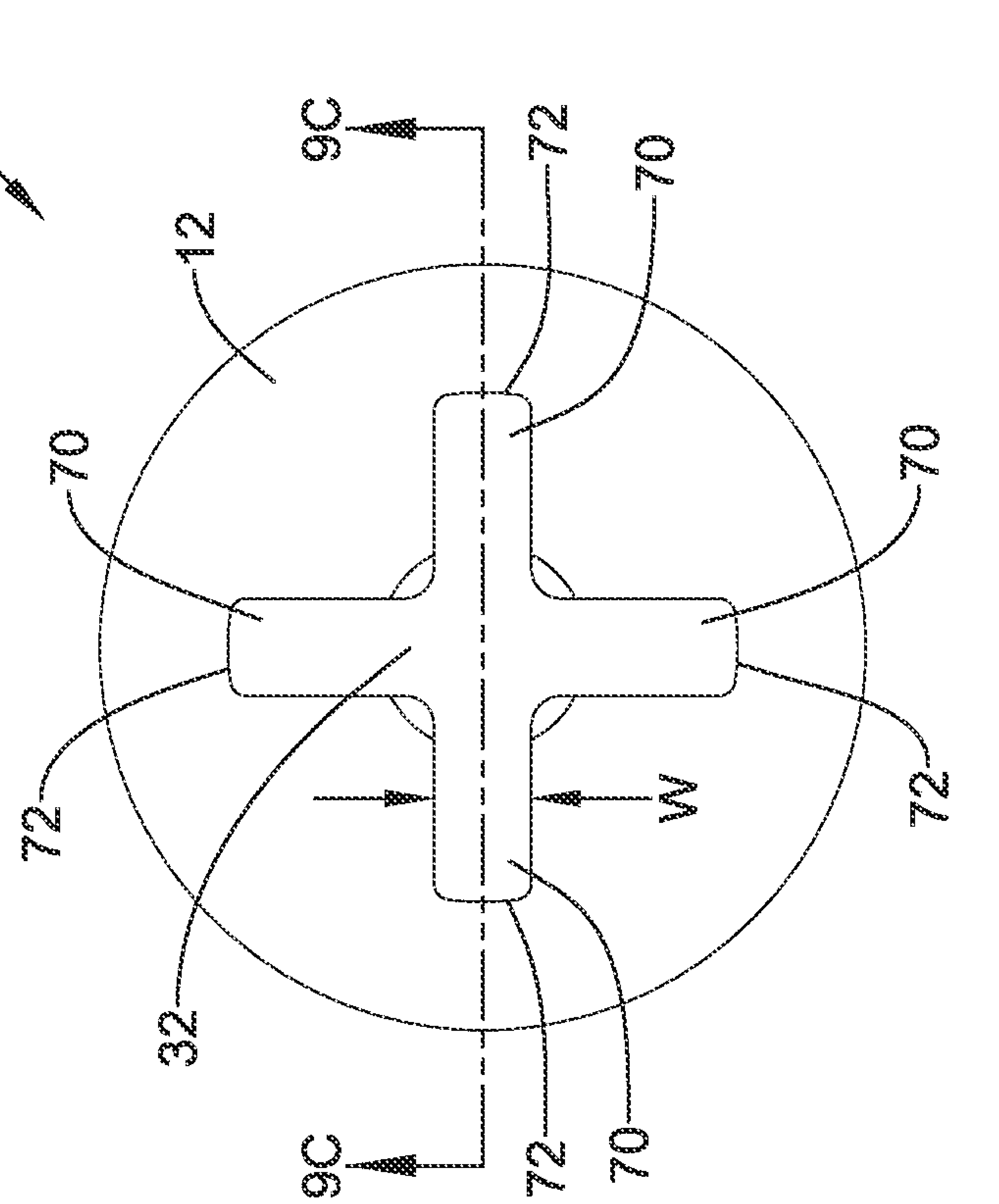


FIG. 9B

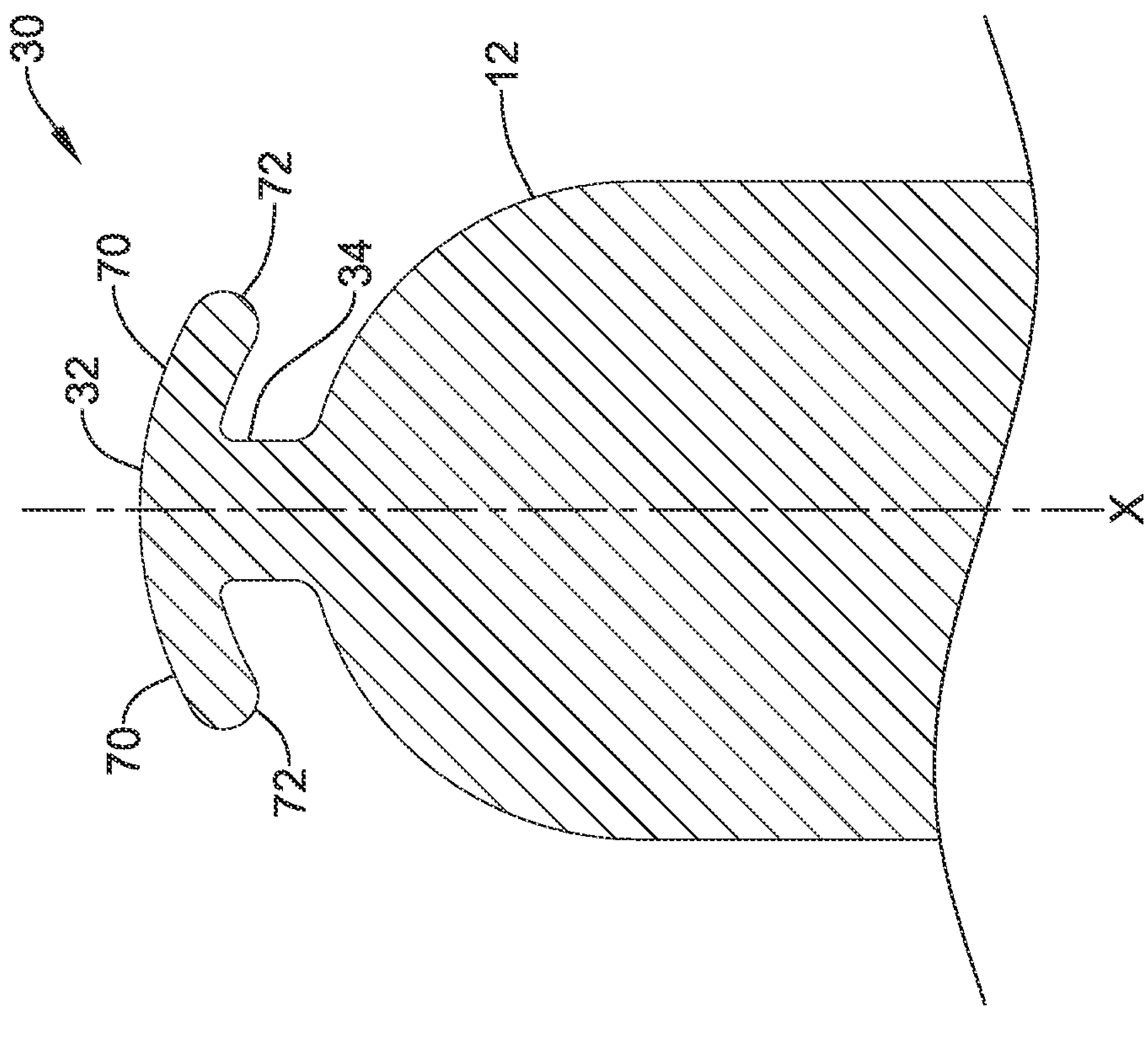


FIG. 9C

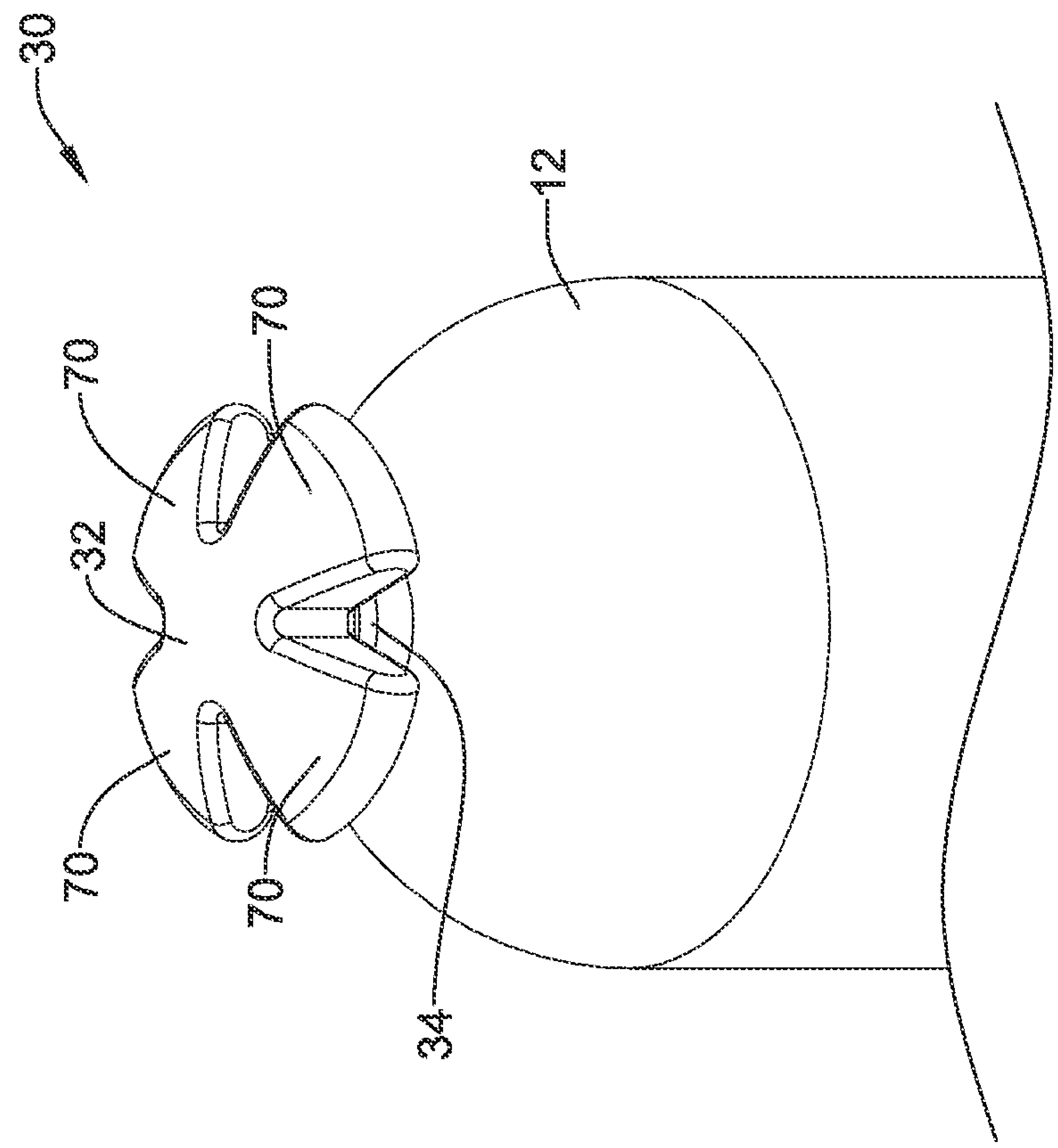


FIG. 10A

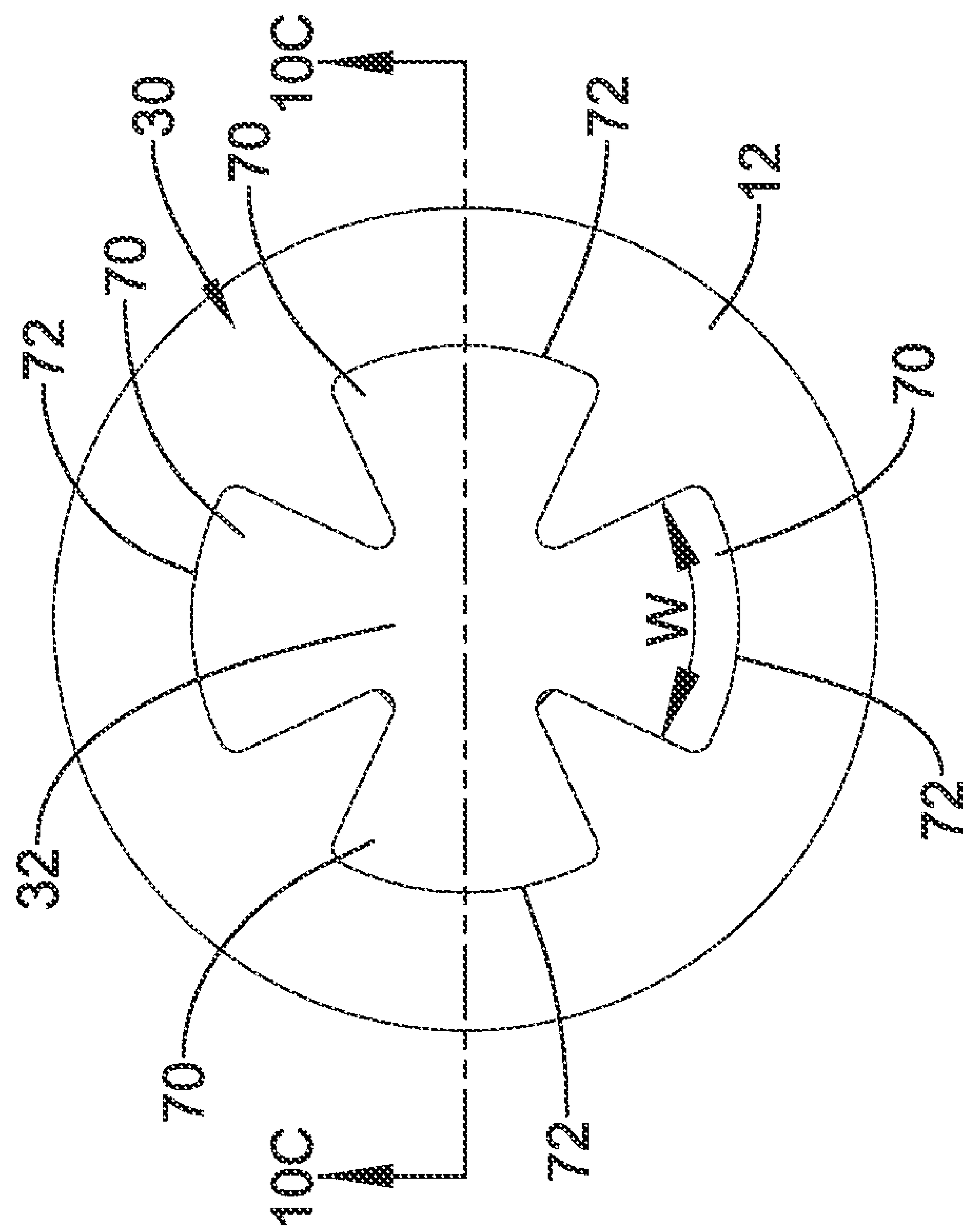


FIG. 10B

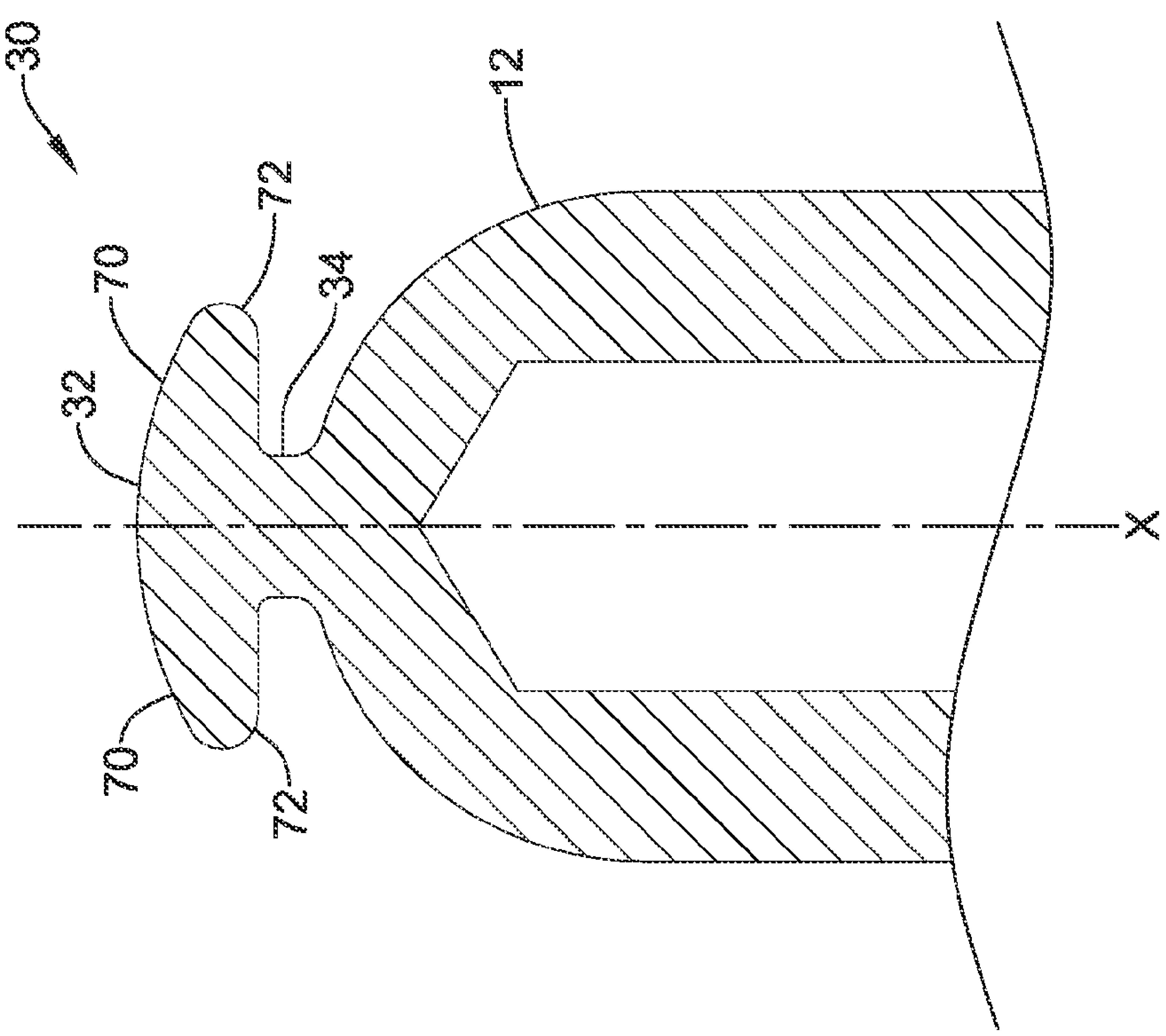


FIG. 10C

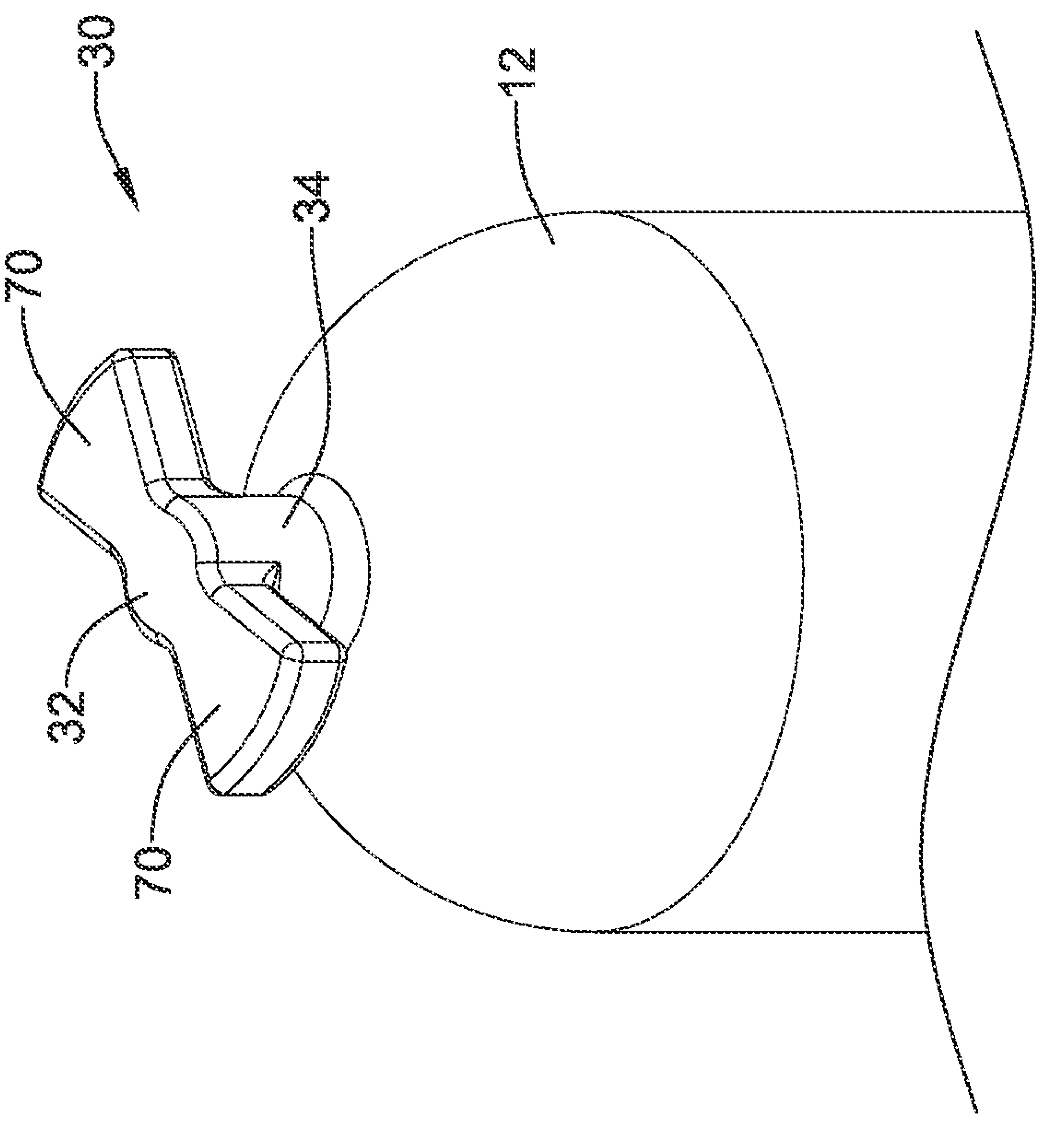


FIG. 11A

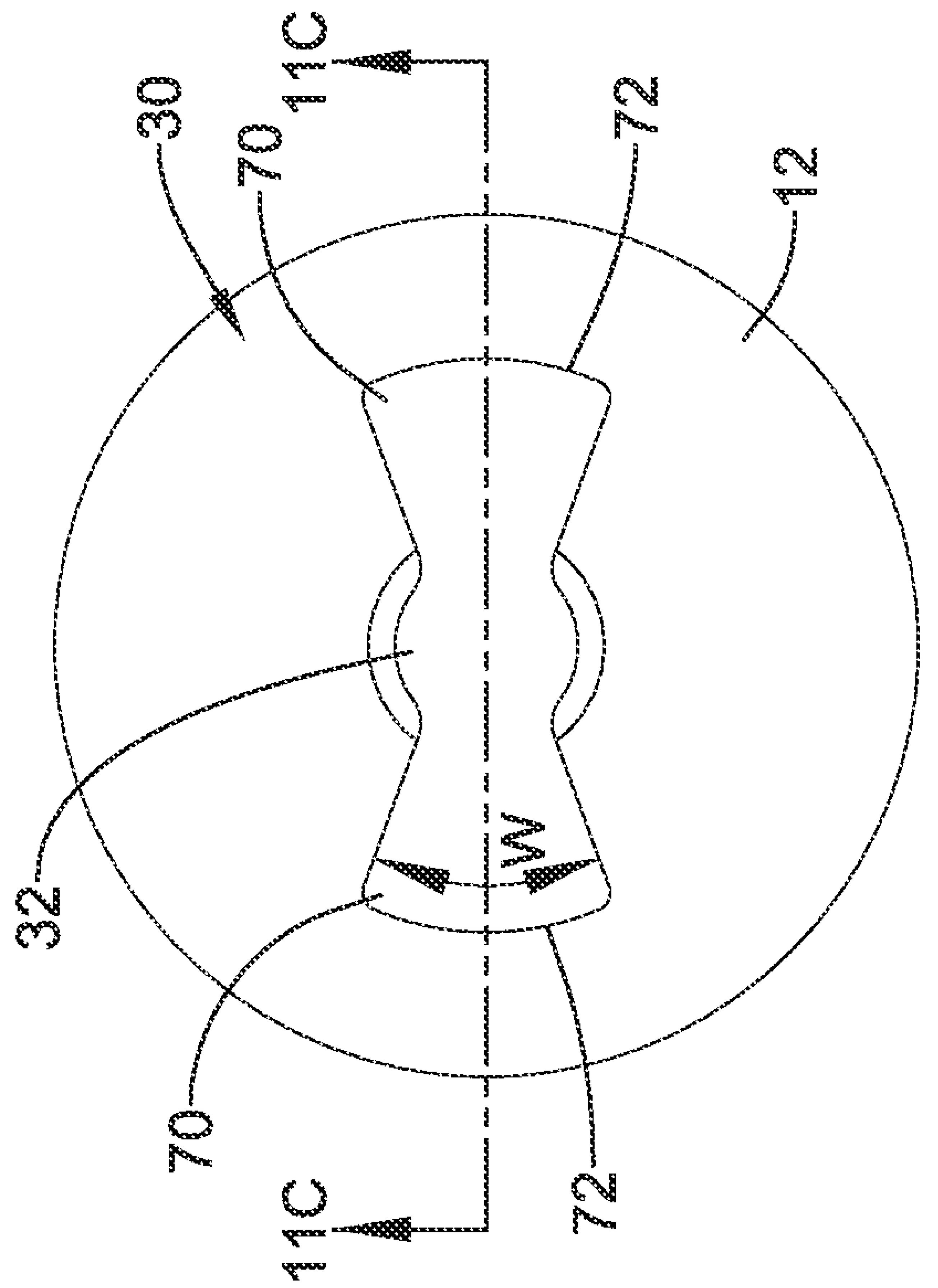


FIG. 11B

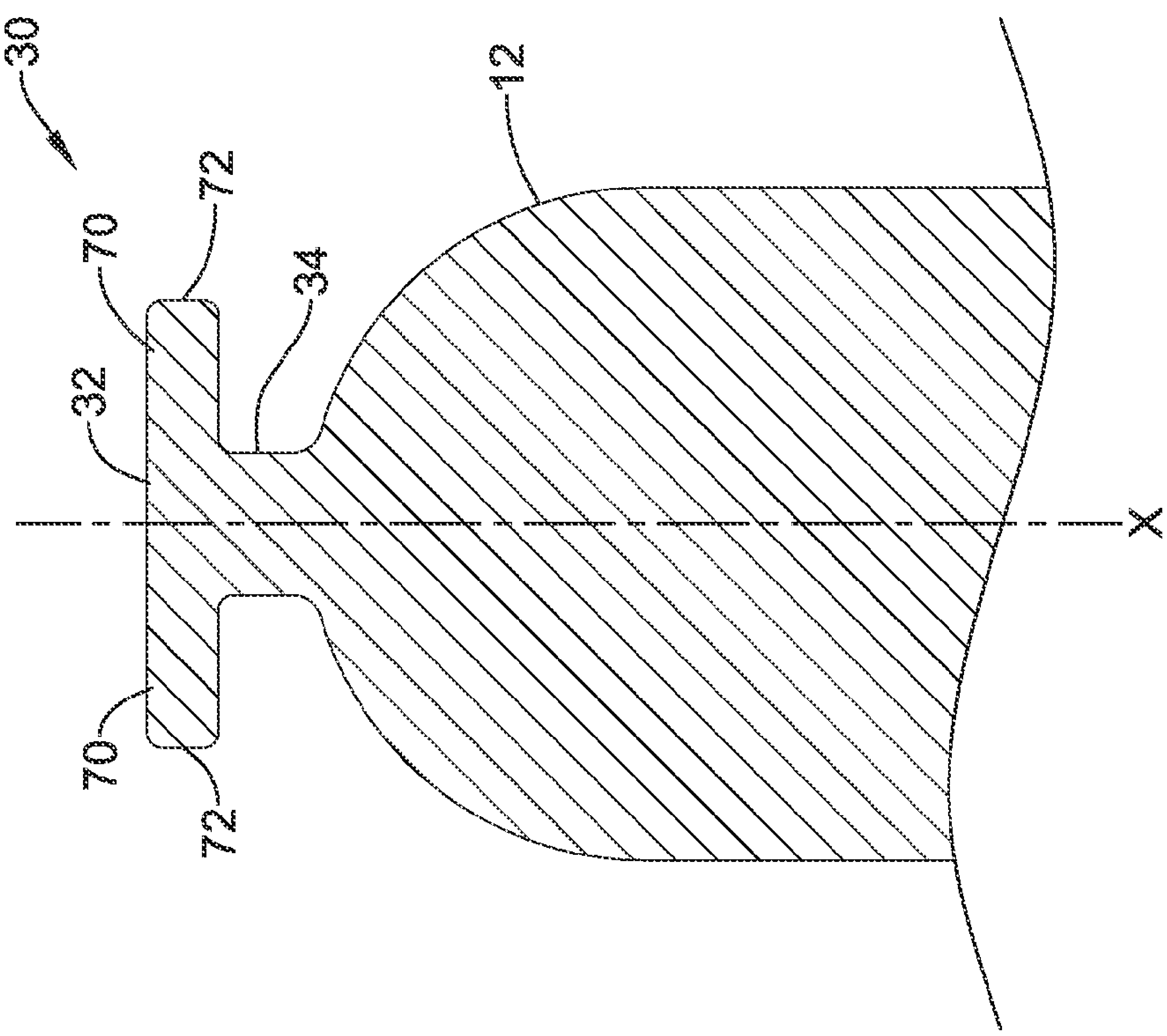


FIG. 11C

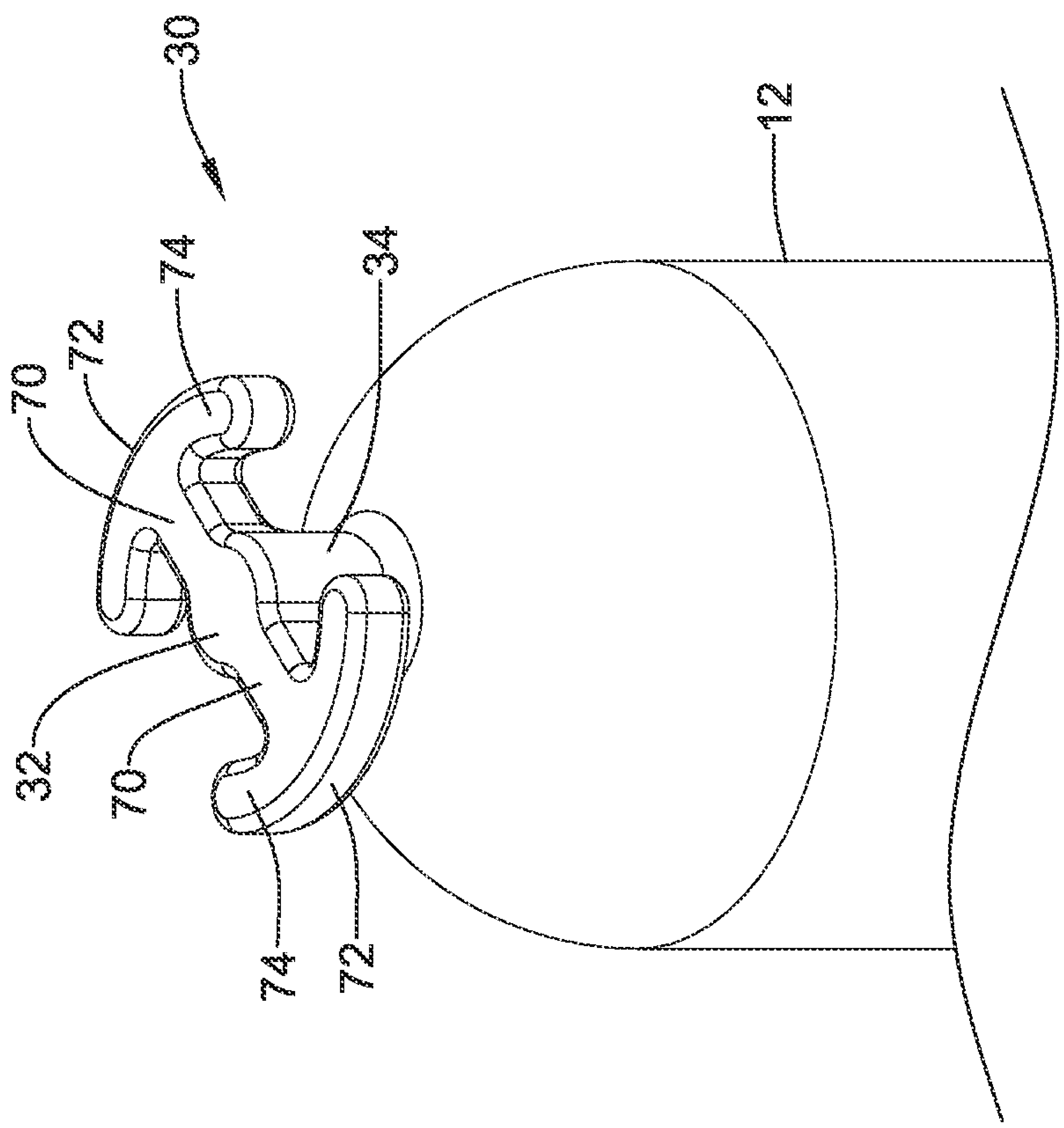


FIG. 12A

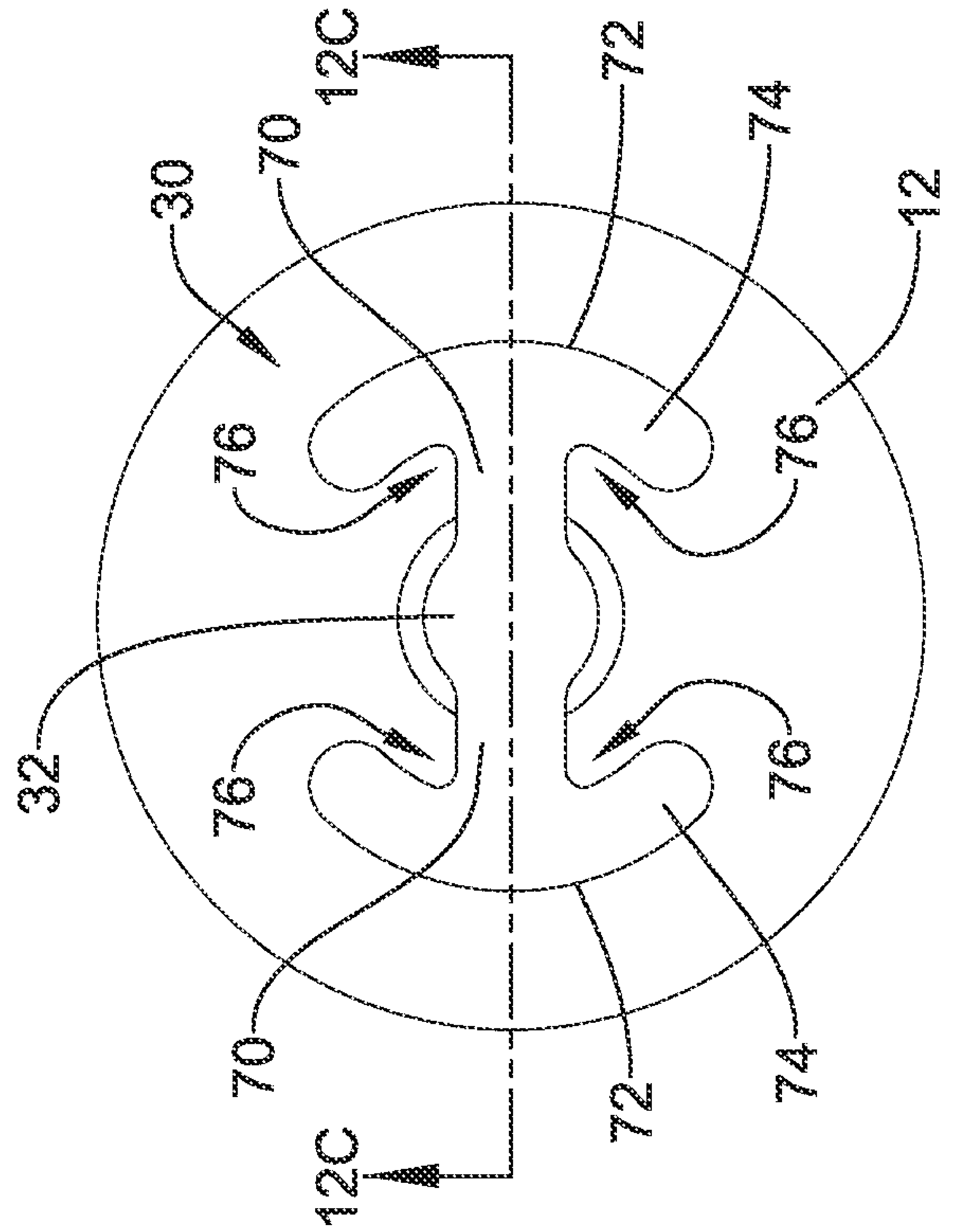


FIG. 12B

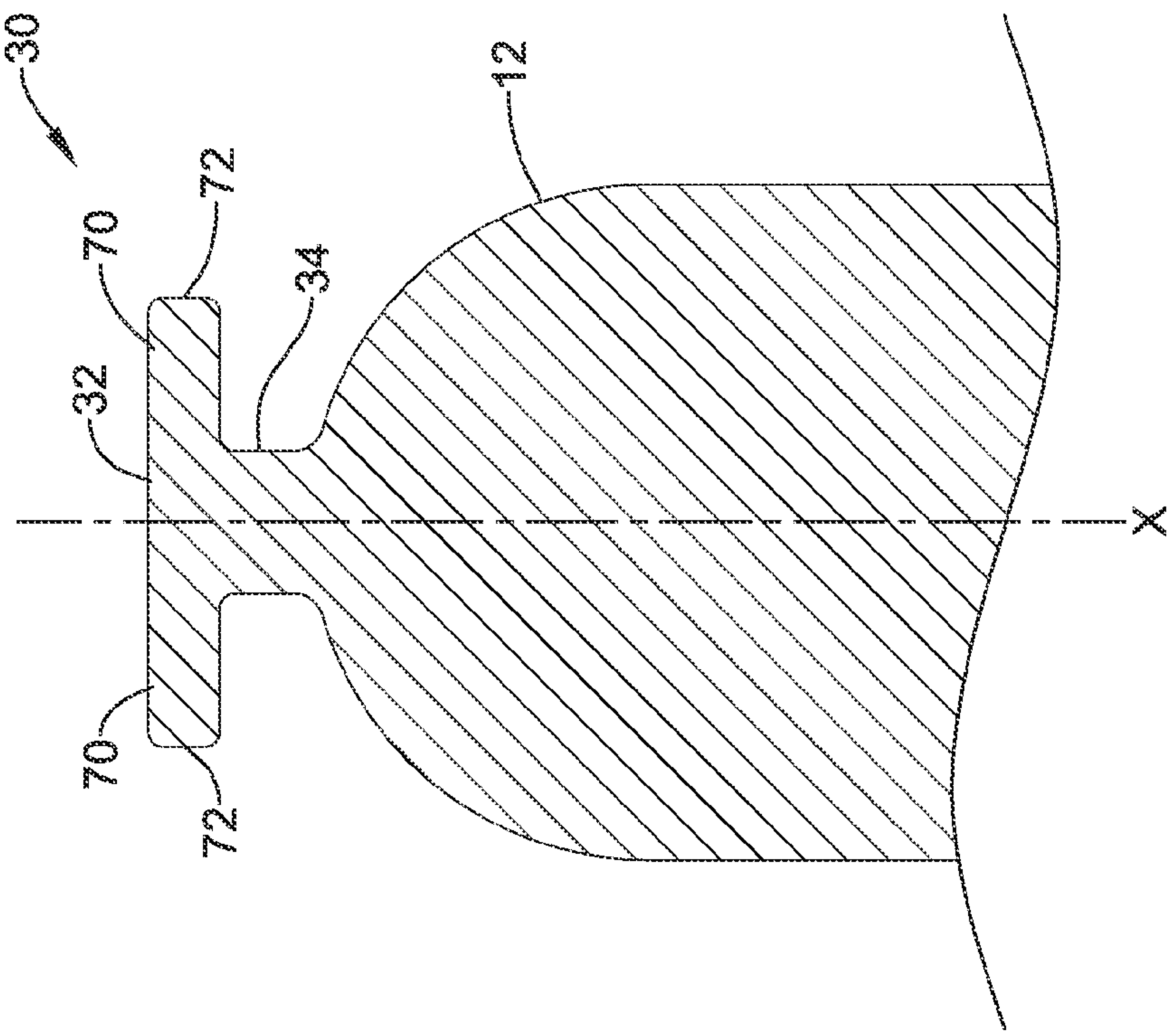


FIG. 12C

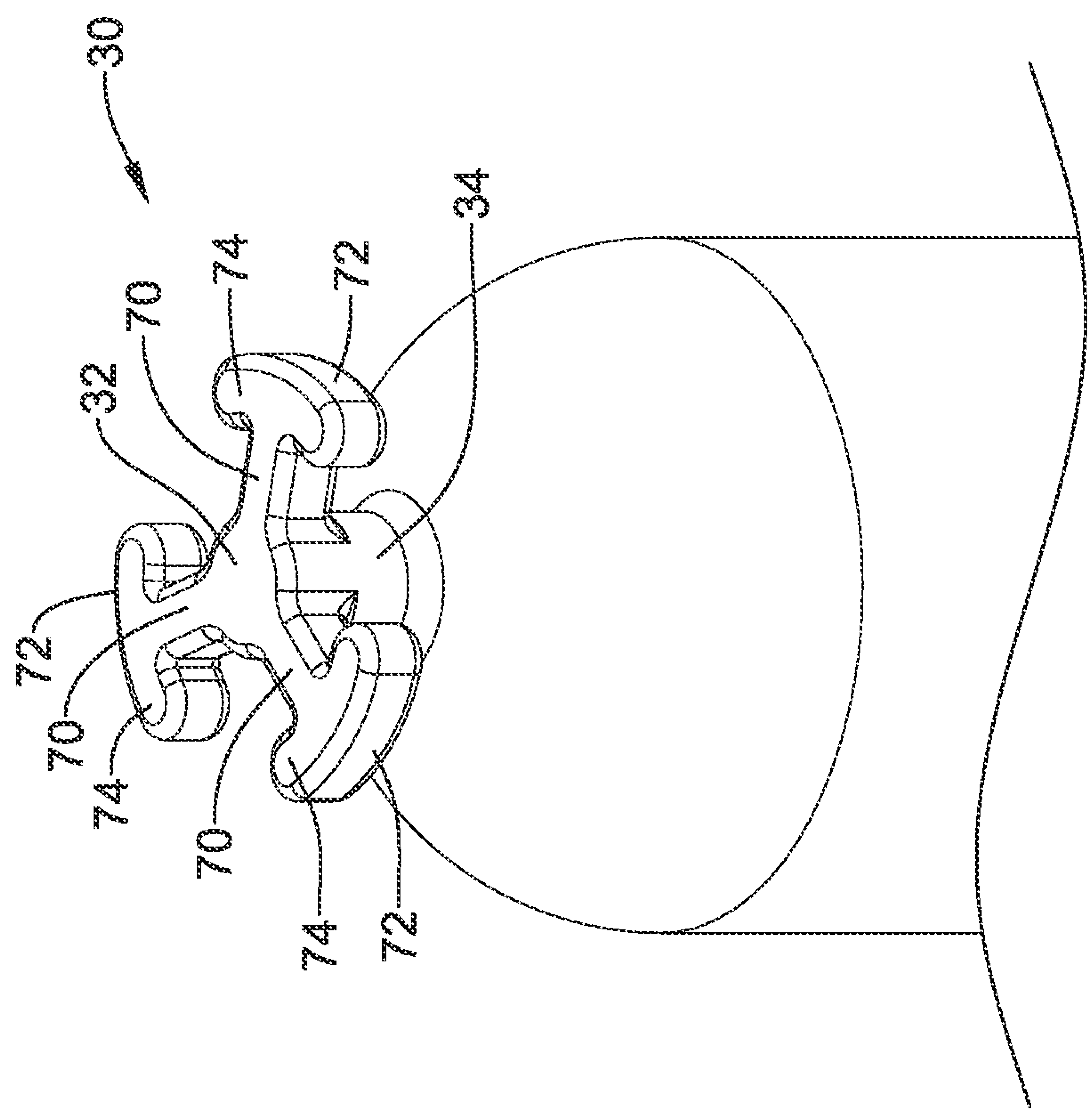


FIG. 13A

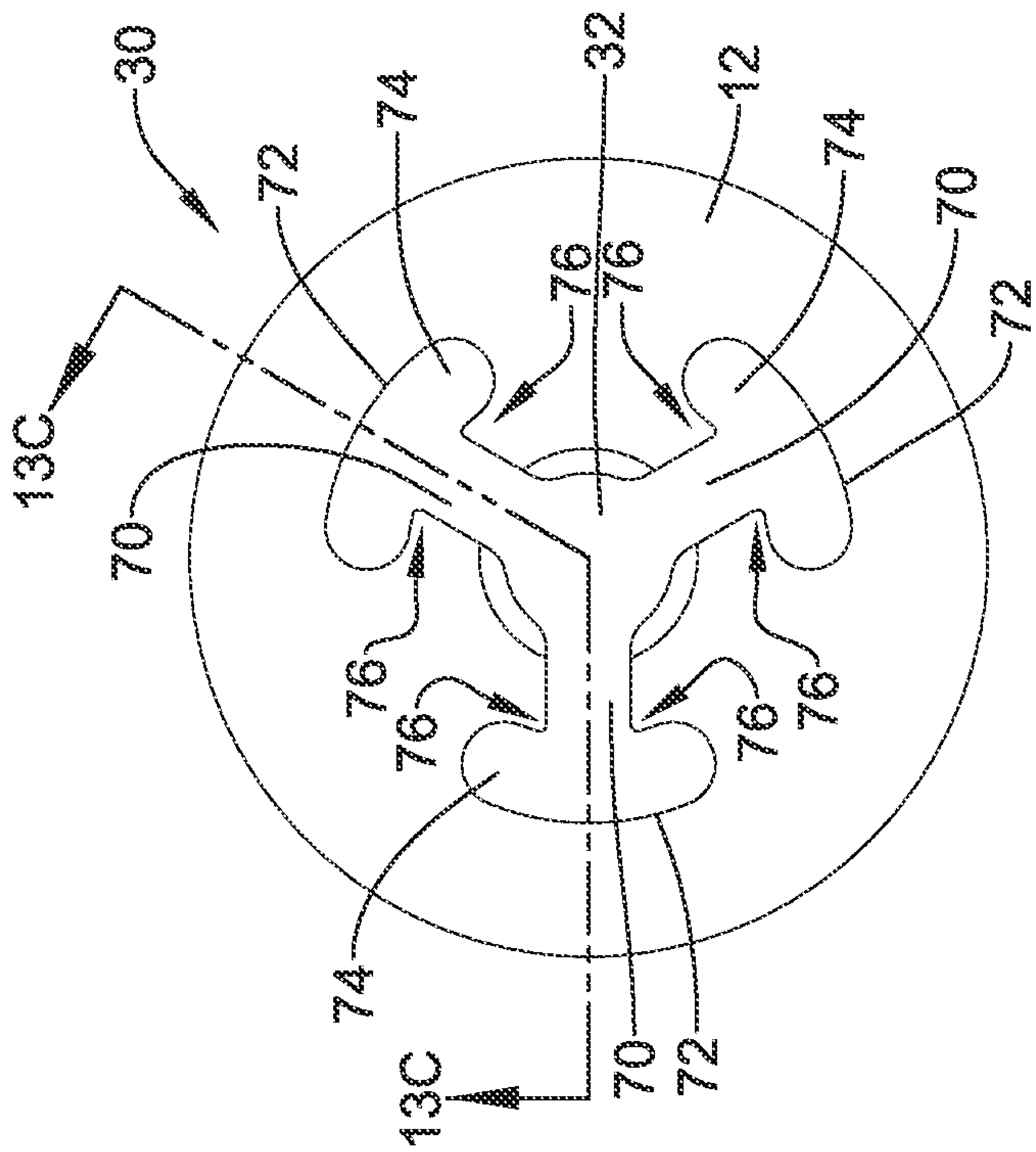


FIG. 13B

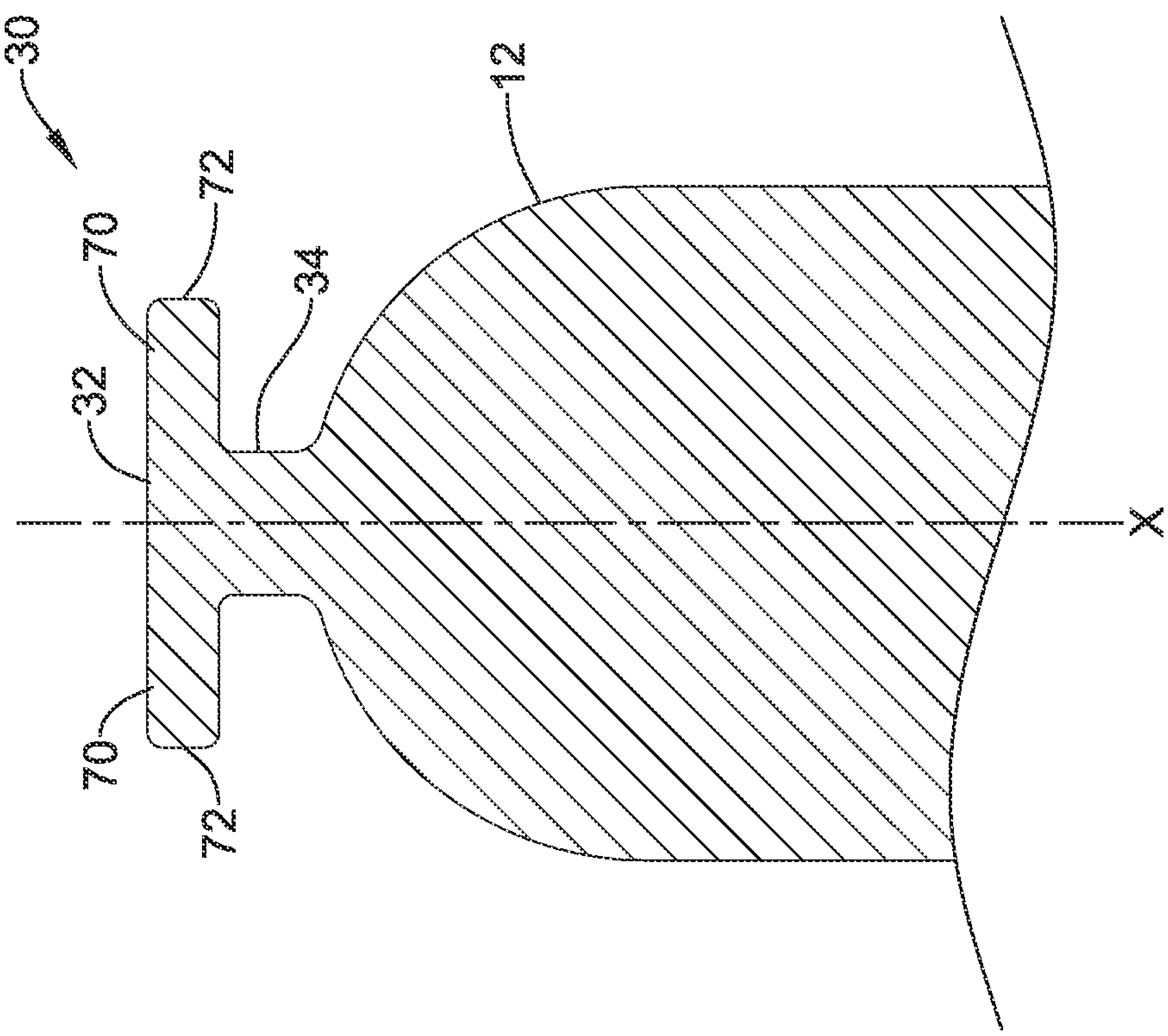


FIG. 13C

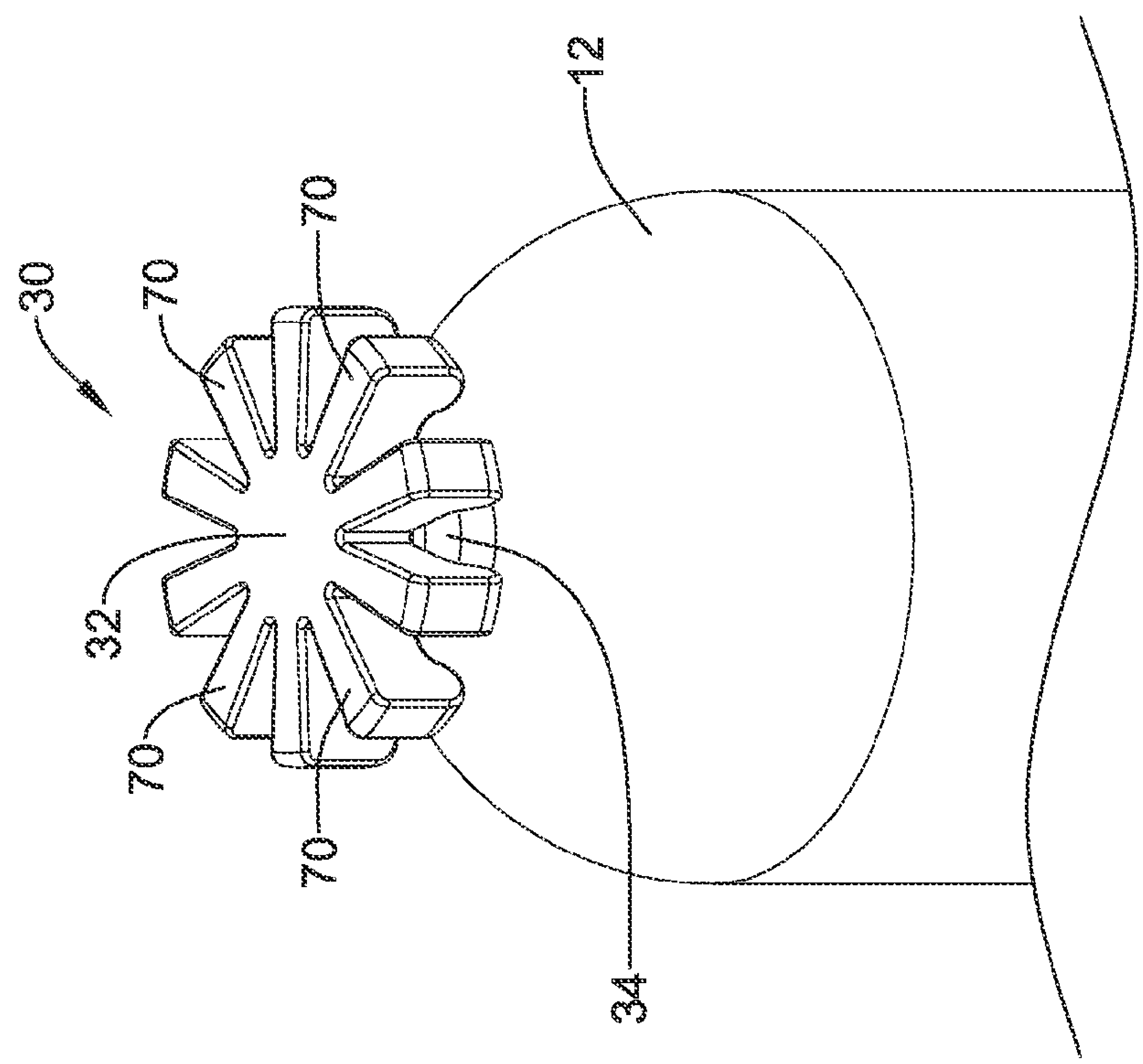


FIG. 14A

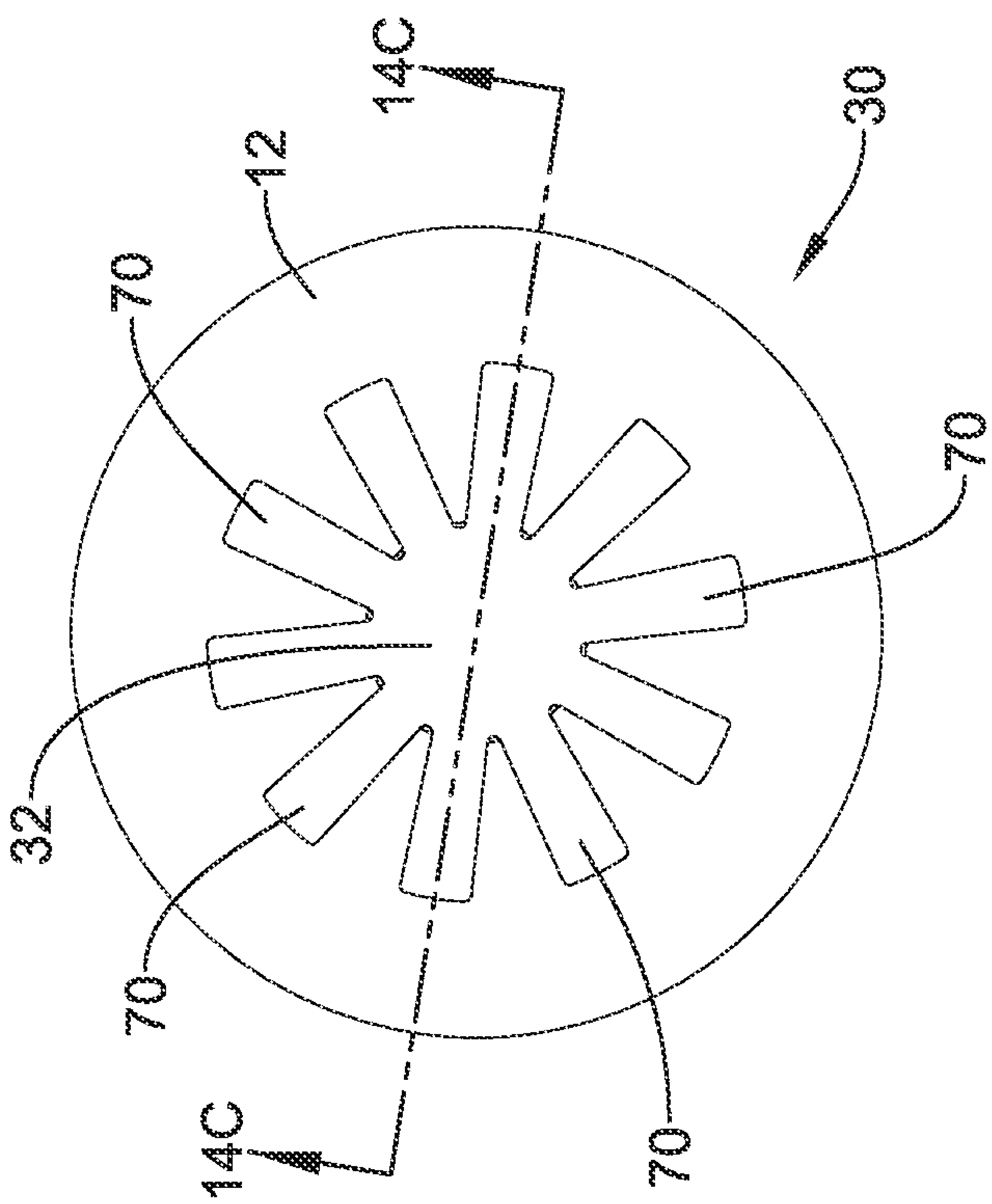


FIG. 14B

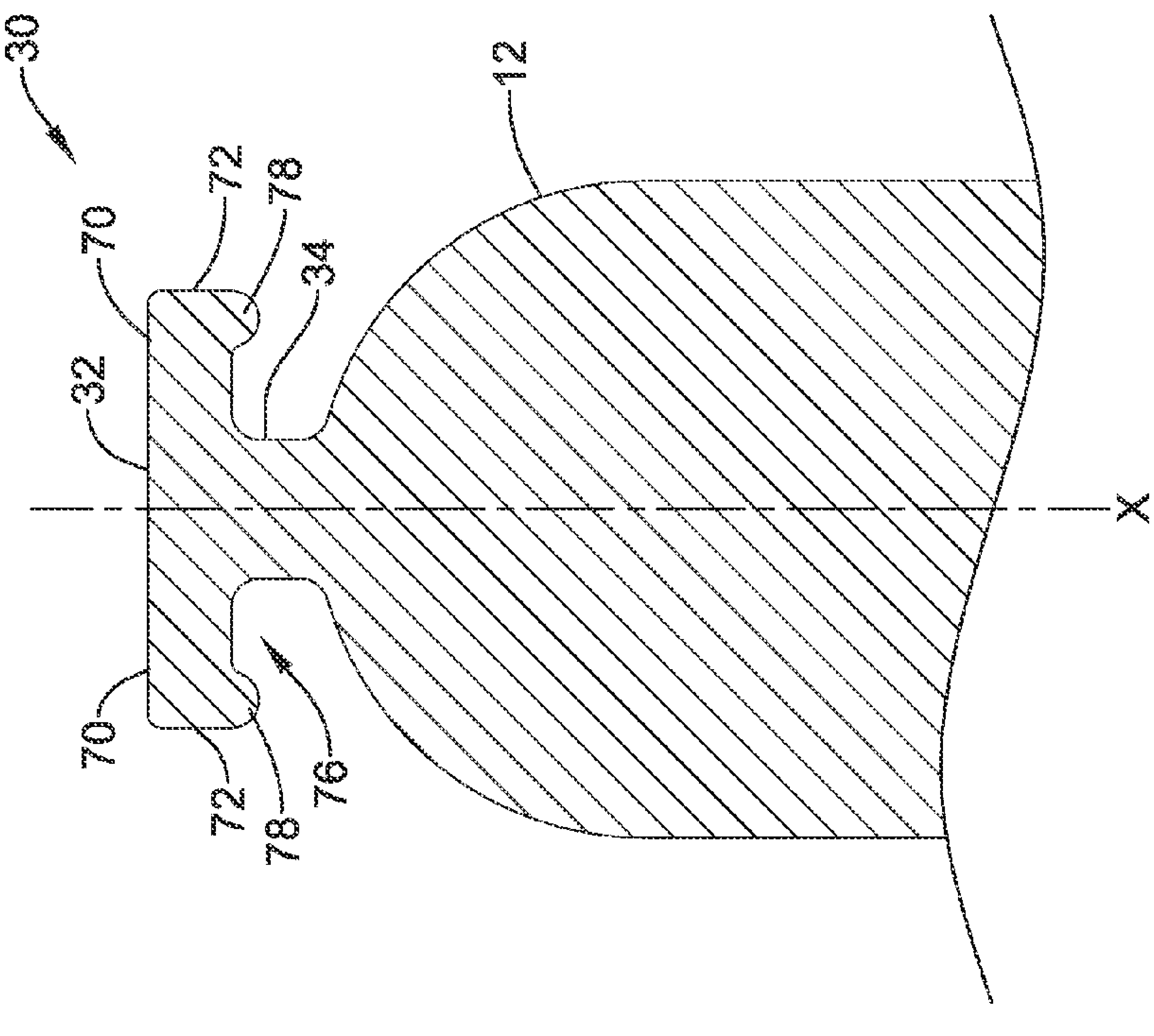


FIG. 14C

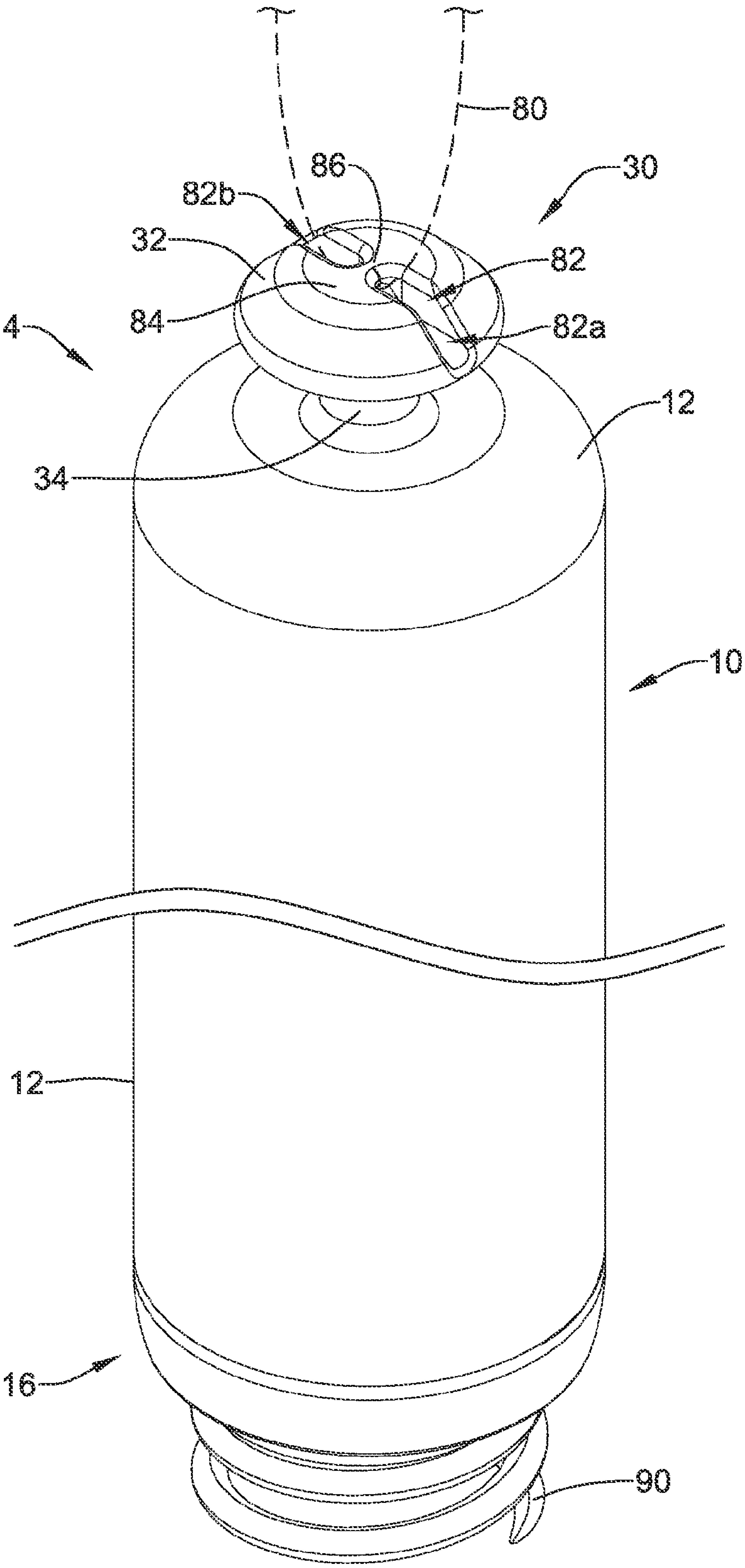


FIG. 15A

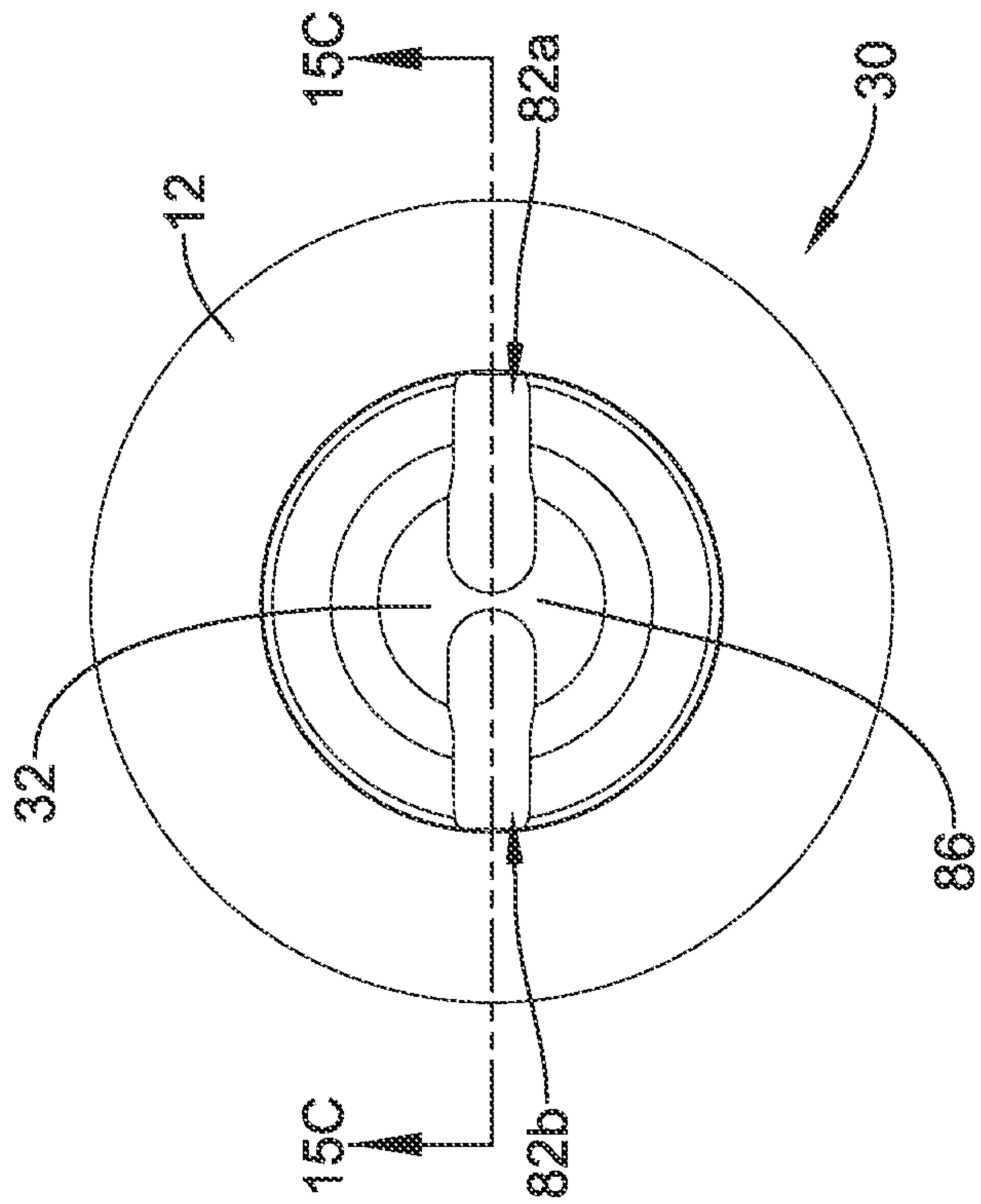


FIG. 15B

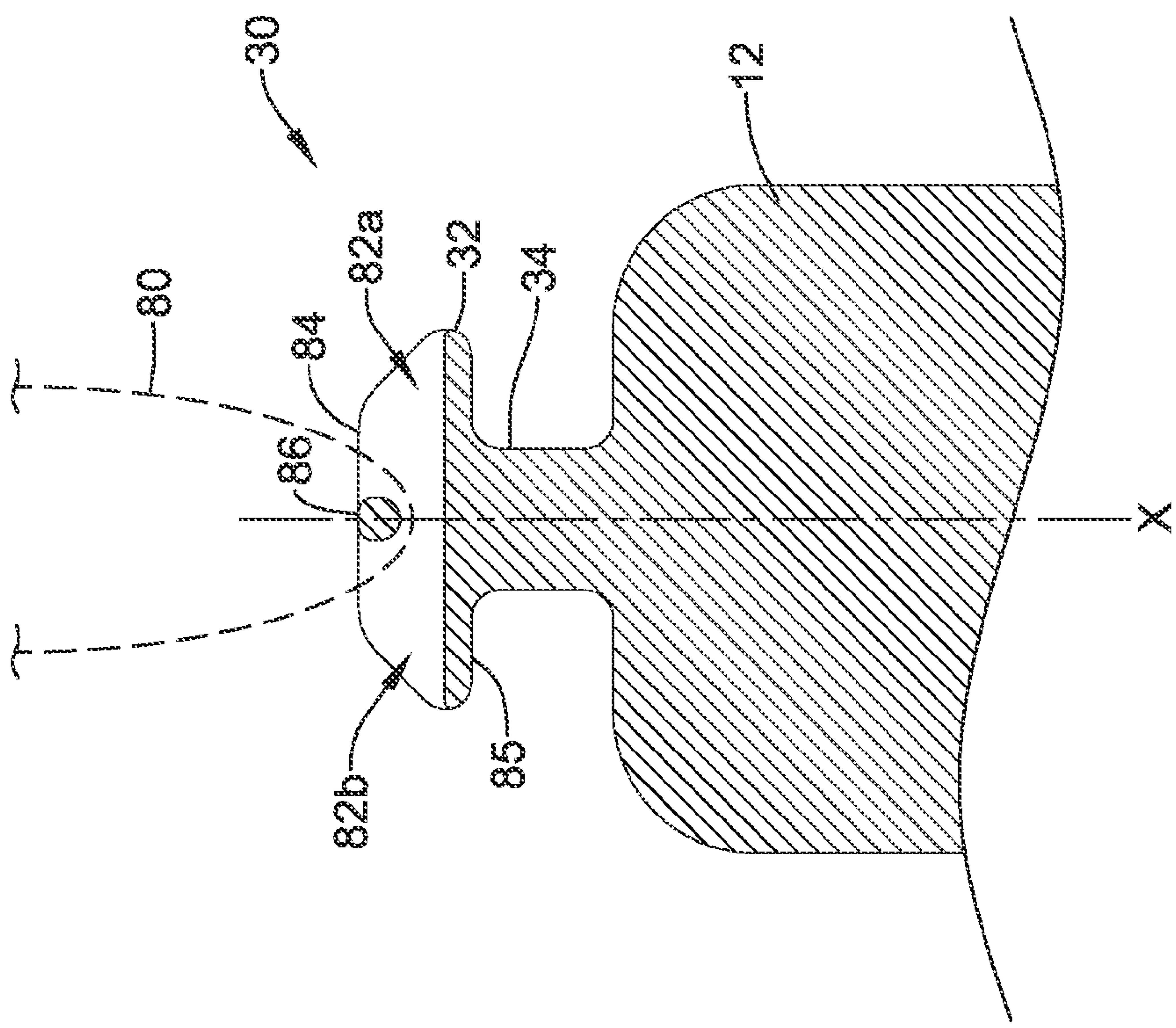


FIG. 15C

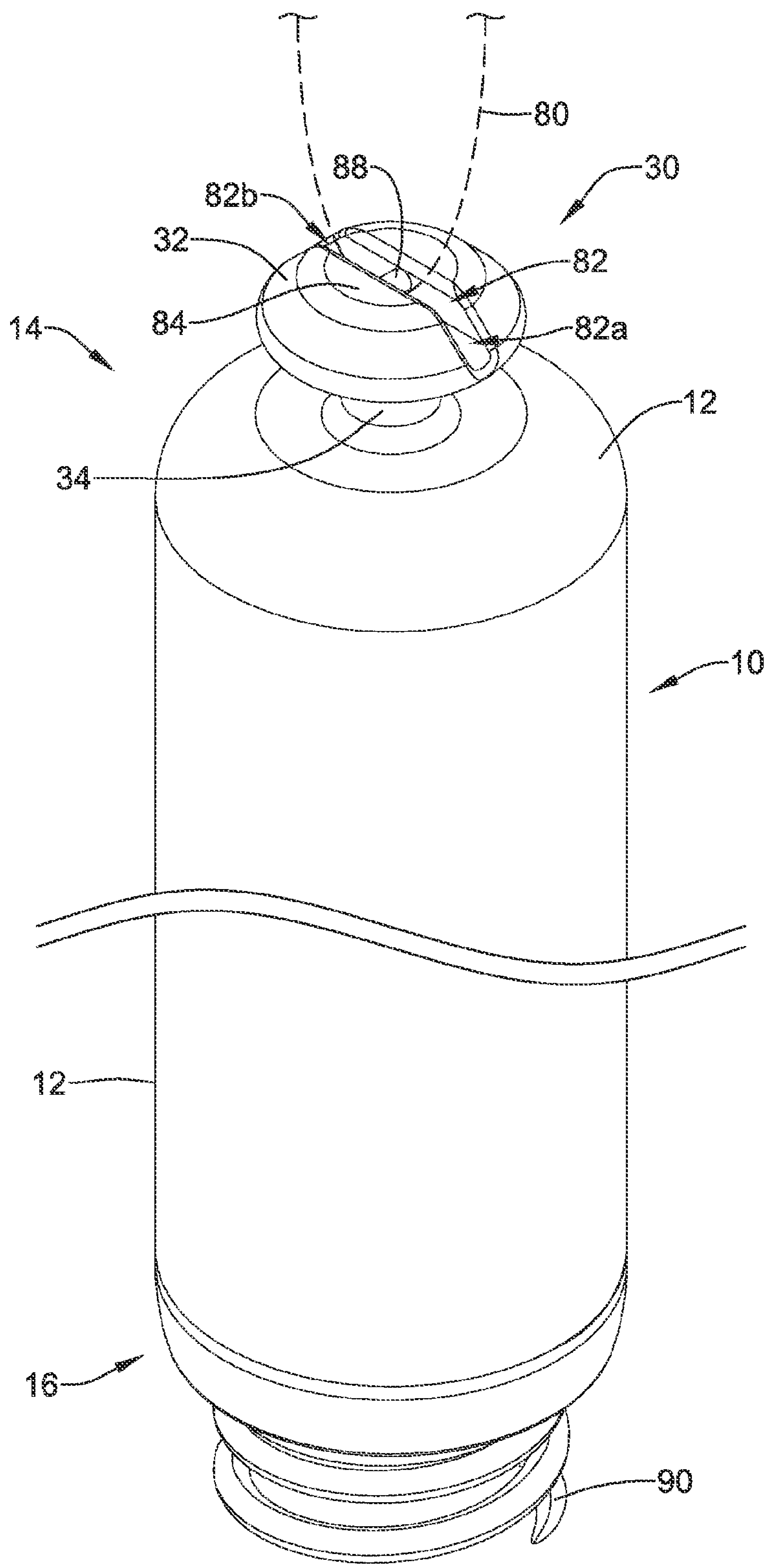


FIG. 16A

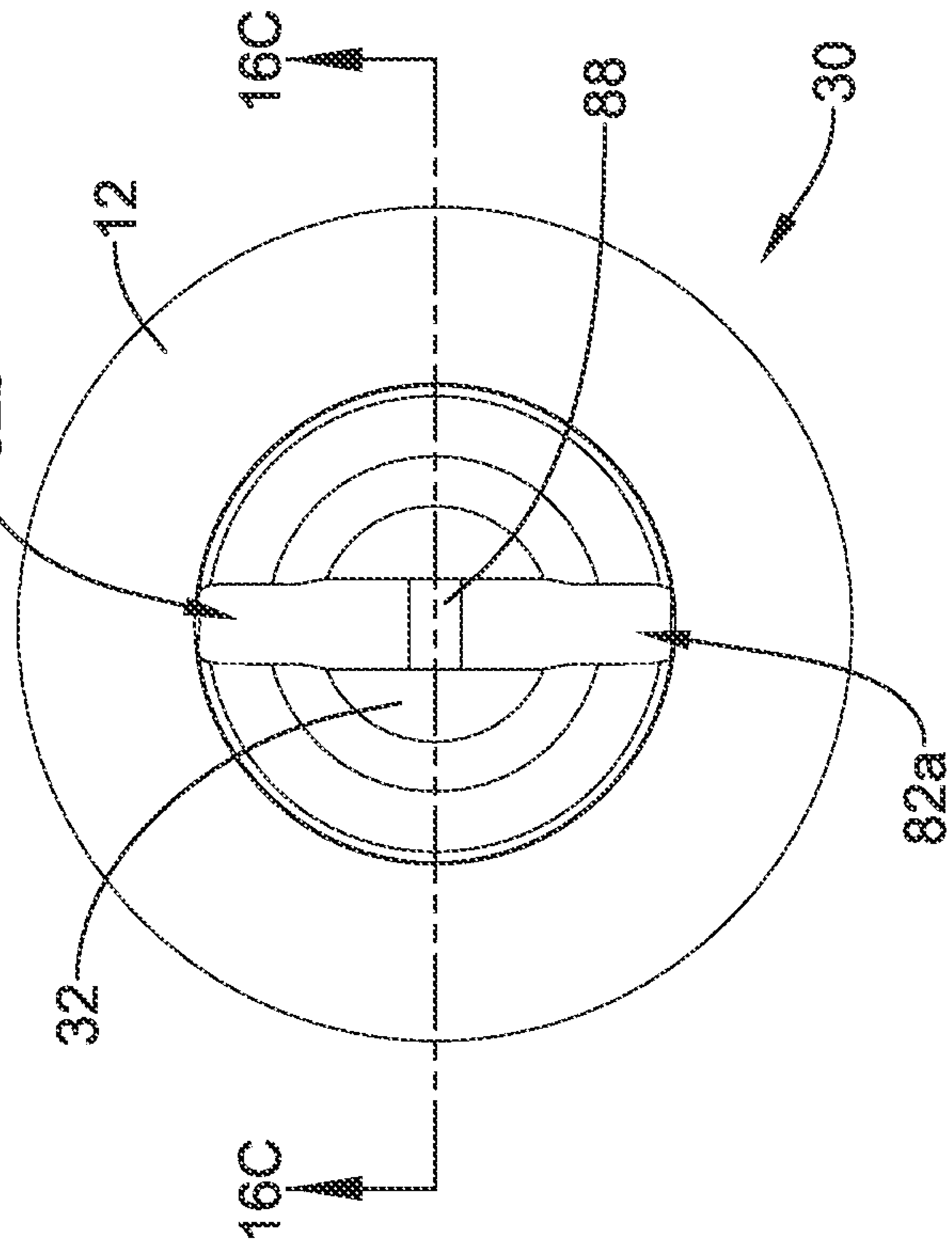


FIG. 16B

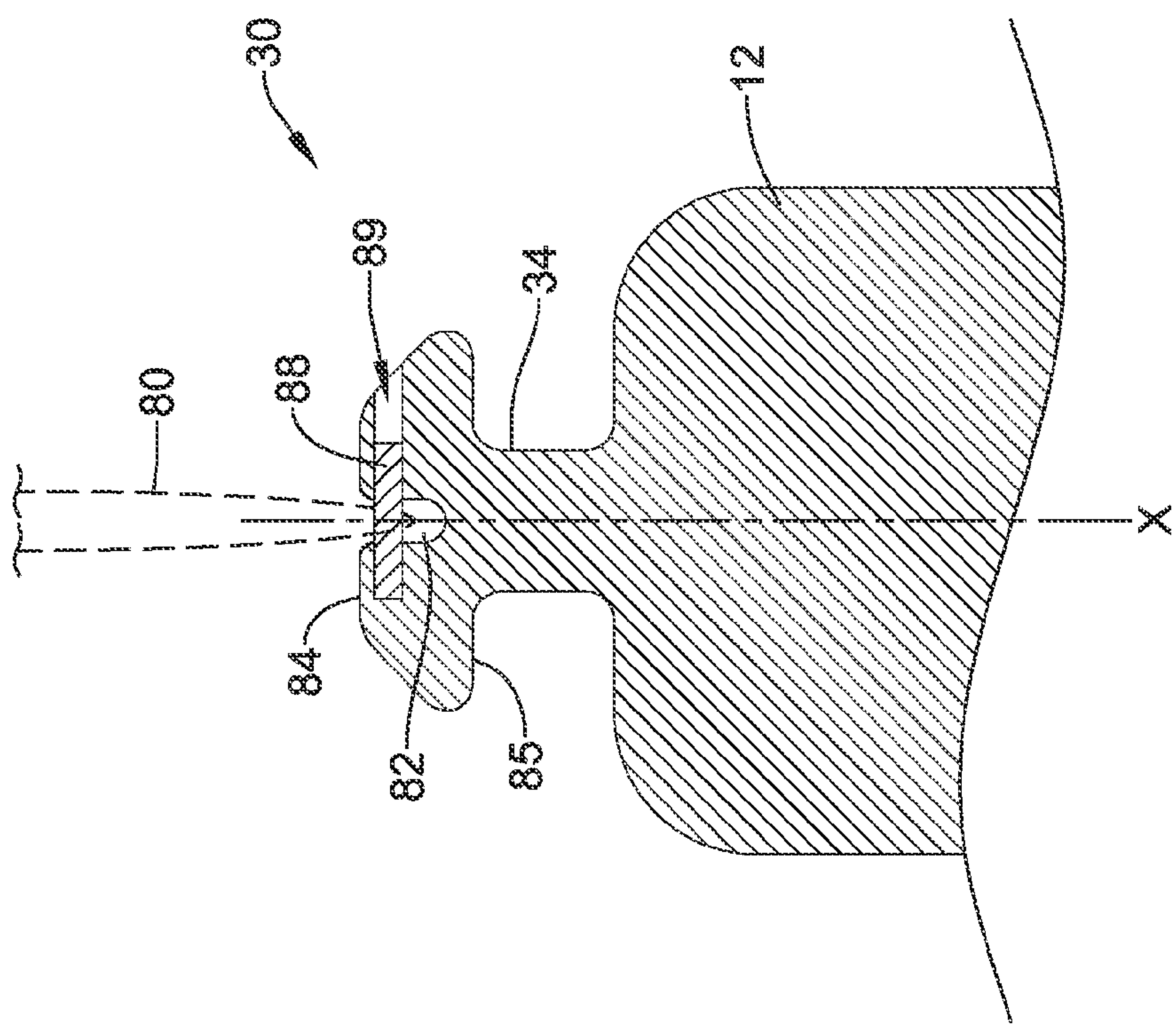


FIG. 16C

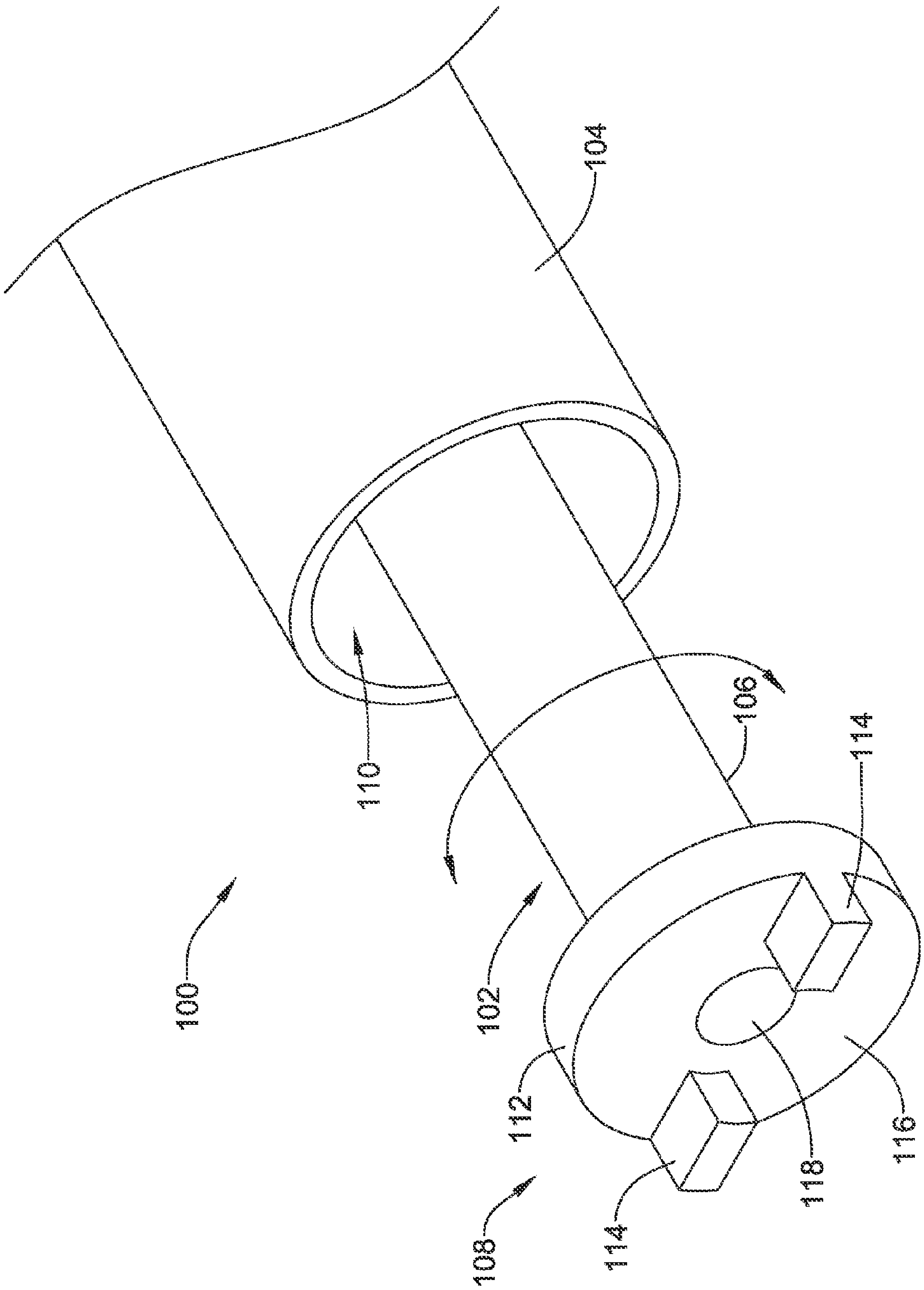


FIG. 17A

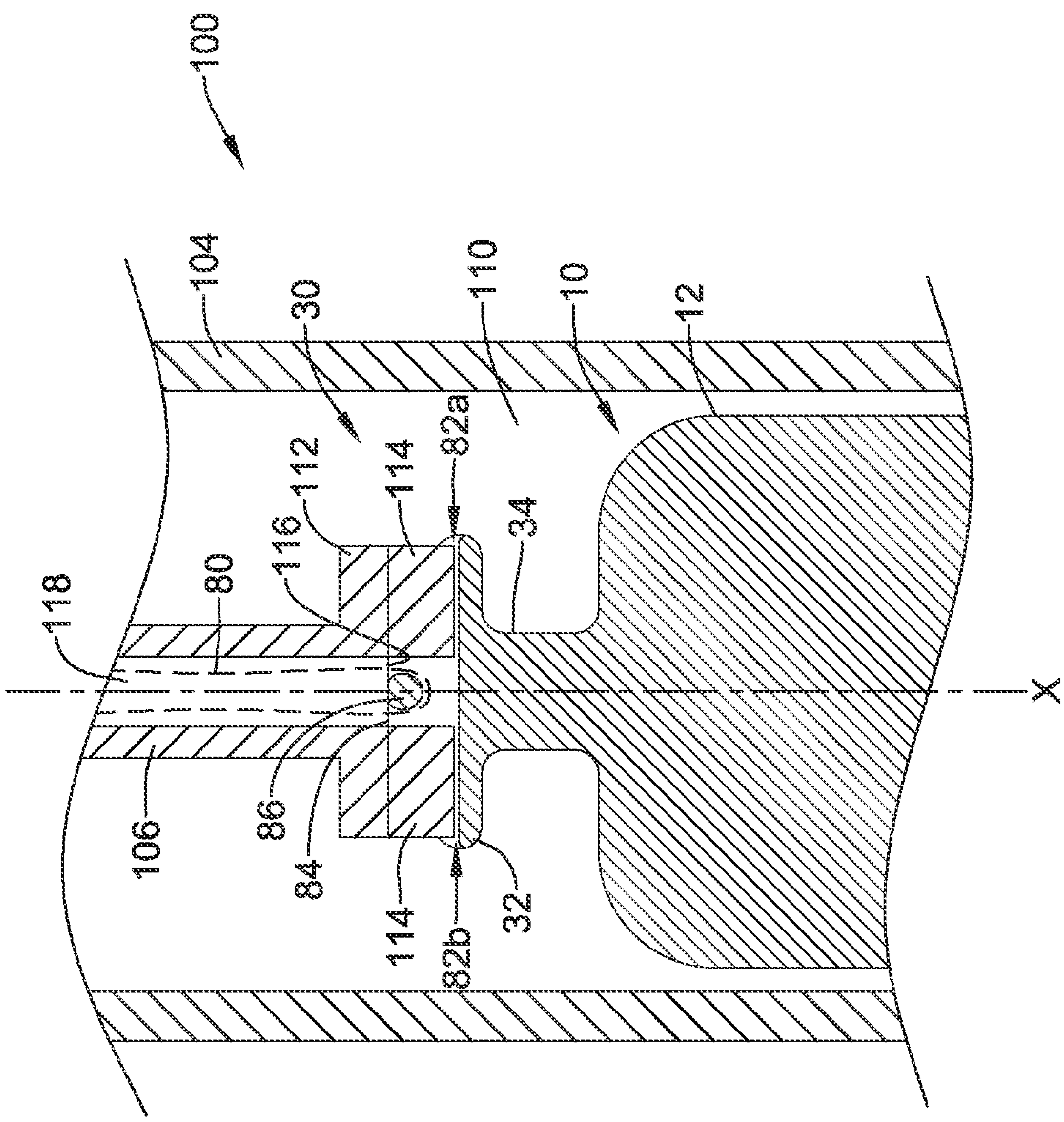
100
104
30
110
10
12
82a
112
114
116
80
118
34
86
106
84
114
82b
32
X

FIG. 17B

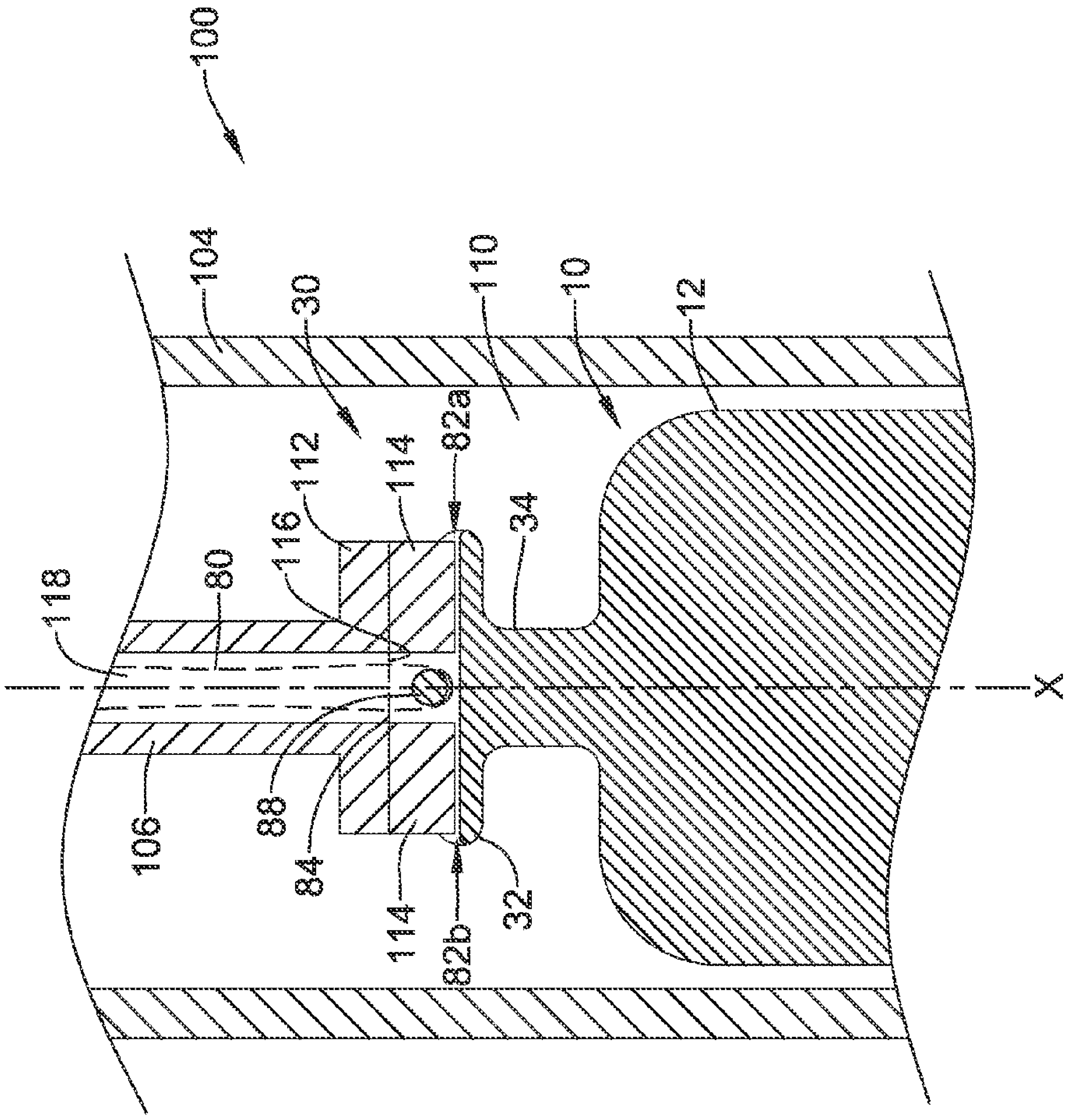
100
104
30
110
10
12
82a
114
112
116
34
118
80
X
106
88
84
114
82b
32

FIG. 17C

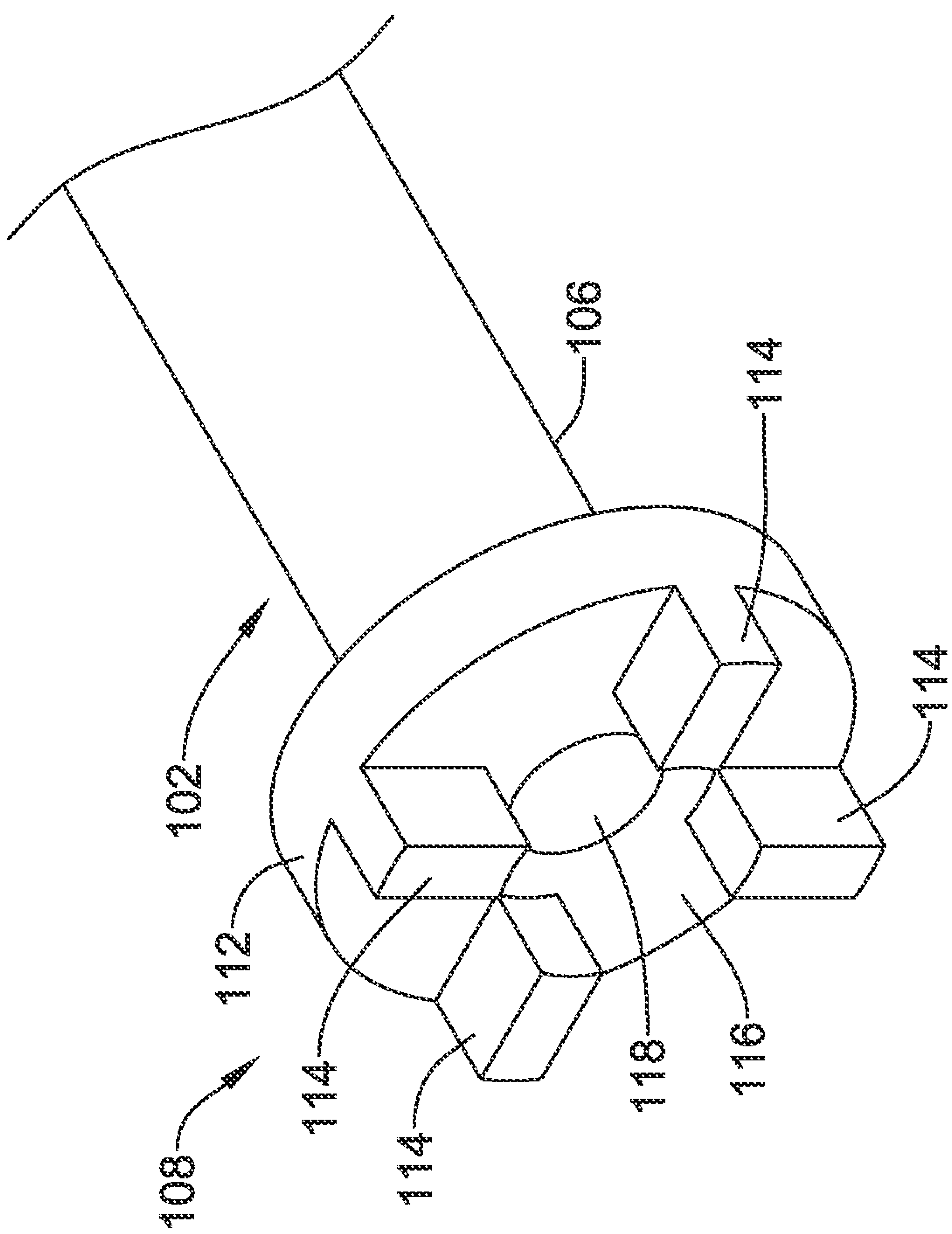


FIG. 18A

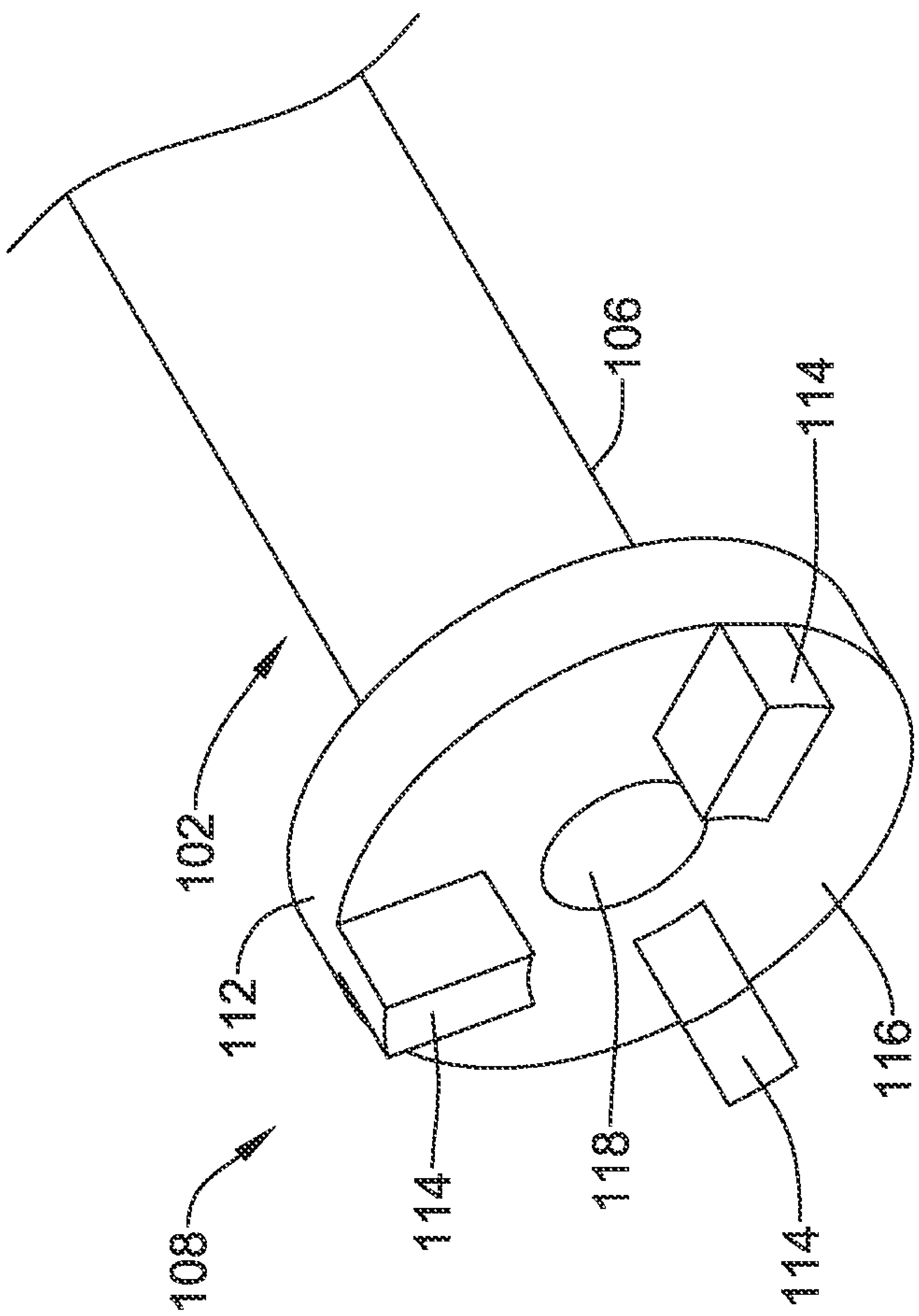


FIG. 18B

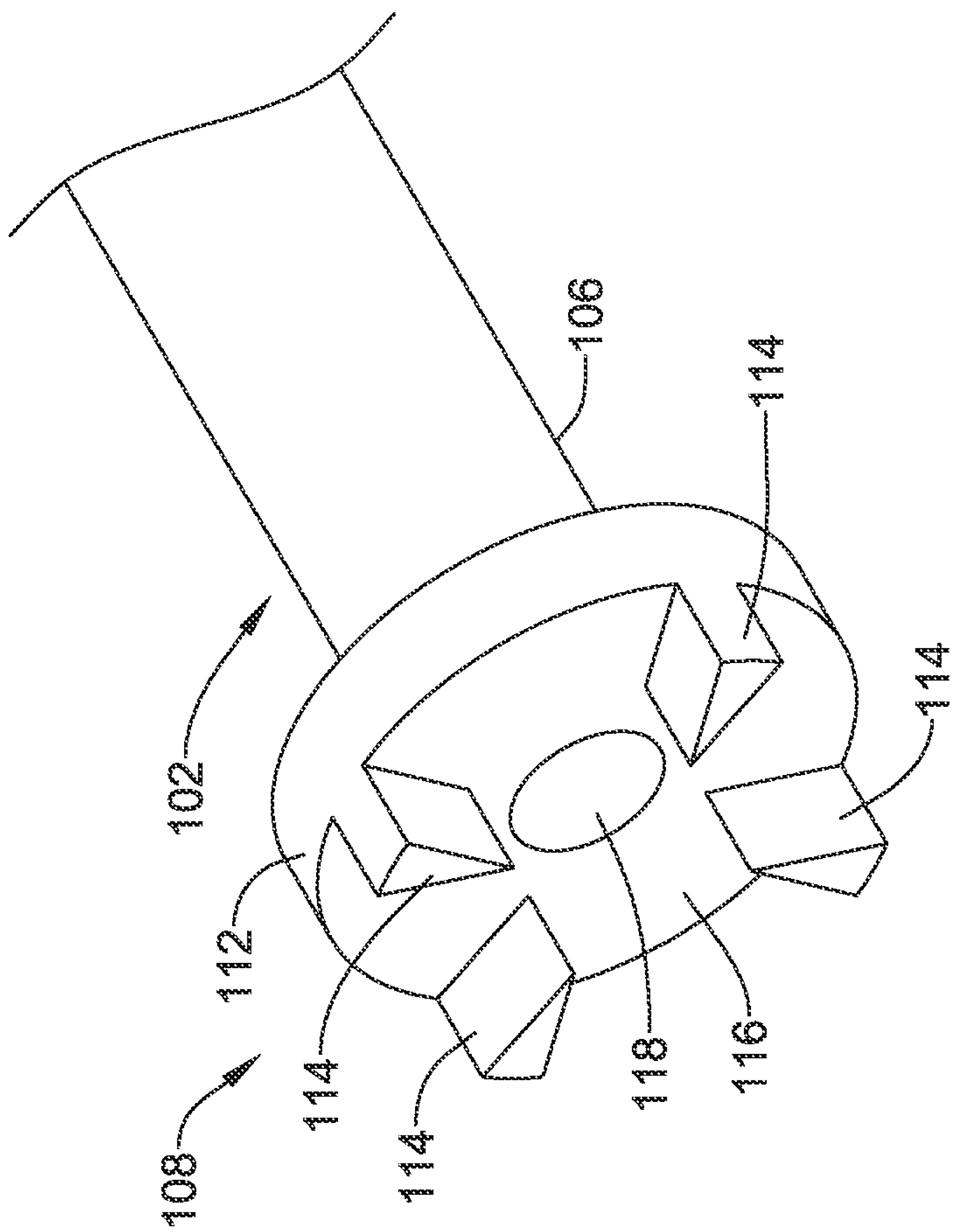


FIG. 18C

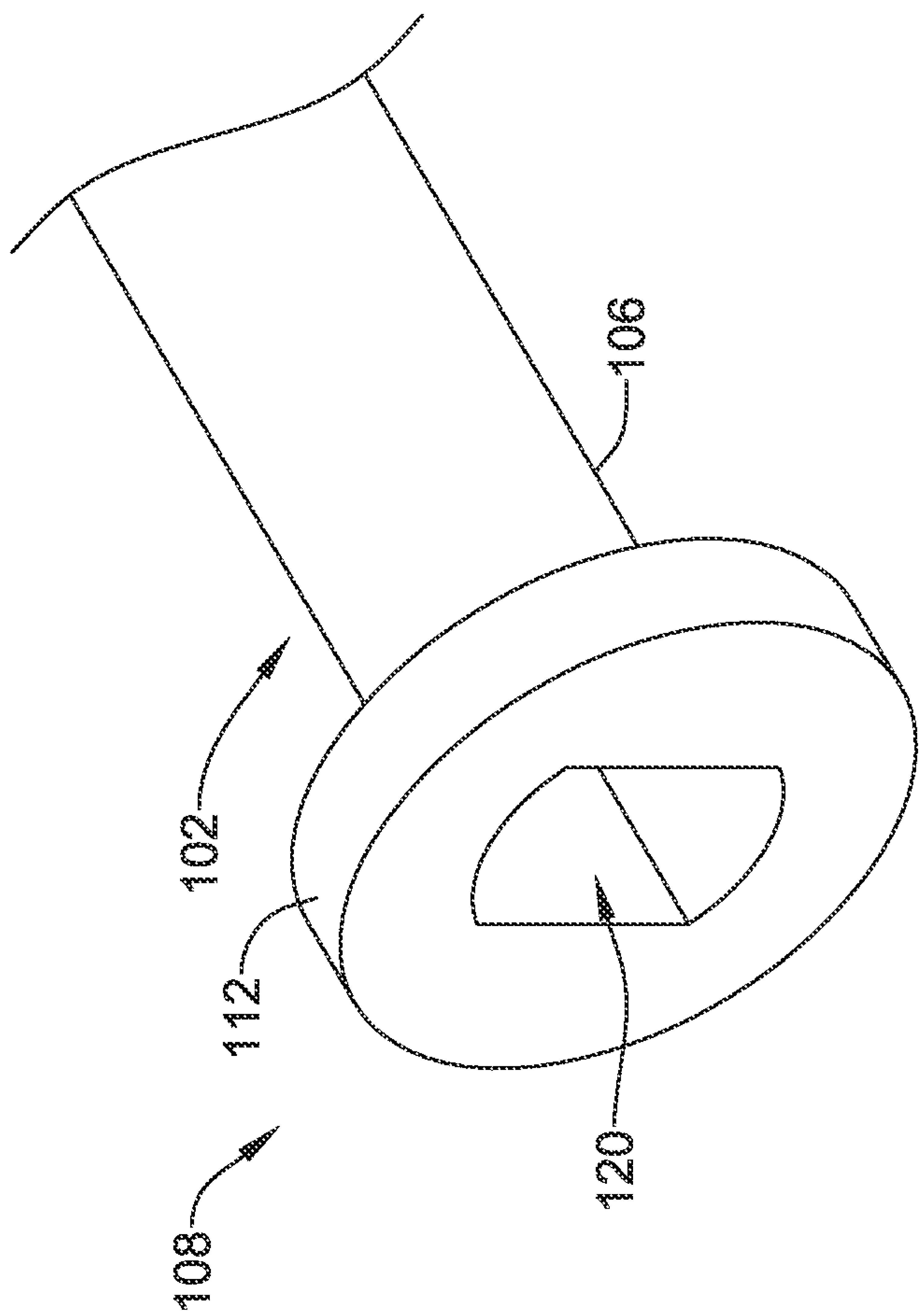


FIG. 18D

# LEADLESS CARDIAC PACEMAKER WITH DELIVERY AND/OR RETRIEVAL FEATURES

## CROSS-REFERENCES TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 61/866,644 filed Aug. 16, 2013, the complete disclosure of which is herein incorporated by reference.

## TECHNICAL FIELD

The disclosure is directed to implantable cardiac devices. More particularly, the disclosure is directed to leadless cardiac stimulators or pacemakers including delivery and/or retrieval features.

## BACKGROUND

Cardiac pacemakers provide electrical stimulation to heart tissue to cause the heart to contract and thus pump blood through the vascular system. Conventional pacemakers typically include an electrical lead that extends from a pulse generator implanted subcutaneously or sub-muscularly to an electrode positioned adjacent the inside or outside wall of the cardiac chamber. As an alternative to conventional pacemakers, self-contained or leadless cardiac pacemakers have been proposed. Leadless cardiac pacemakers are small capsules typically fixed to an intracardiac implant site in a cardiac chamber with a fixation mechanism engaging the intracardiac tissue. The small capsule typically includes bipolar pacing/sensing electrodes, a power source (e.g. a battery), and associated electrical circuitry for controlling the pacing/sensing electrodes, and thus provide electrical stimulation to heart tissue and/or sense a physiological condition.

Accordingly, there it is desirable to provide alternative structures to facilitate delivering leadless cardiac pacemakers to an implantation site in a heart chamber and/or retrieving leadless cardiac pacemakers from an implantation site in a heart chamber.

## SUMMARY

The disclosure is directed to several alternative designs, materials and methods of manufacturing medical device structures and assemblies, and uses thereof.

Accordingly, one illustrative embodiment is an implantable leadless cardiac pacing device. The implantable device includes a housing, an electrode positioned proximate the distal end of the housing configured to be positioned adjacent cardiac tissue, and a docking member extending from the proximal end of the housing along a longitudinal axis of the housing. The docking member is configured to facilitate retrieval of the implantable leadless cardiac pacing device. The docking member includes a head portion and a neck portion extending between the housing and the head portion. The head portion has a radial dimension from the longitudinal axis and the neck portion has a radial dimension from the longitudinal axis less than the radial dimension of the head portion. The head portion includes a recess extending into the head portion from a proximal surface of the head portion for receiving a rotational driving instrument.

Another illustrative embodiment is an implantable leadless cardiac pacing device. The implantable device includes a housing, an electrode positioned proximate the distal end of the housing configured to be positioned adjacent cardiac tissue, and a docking member extending from the proximal end of the housing along a longitudinal axis of the housing. The docking member is configured to facilitate retrieval of the implantable leadless cardiac pacing device. The docking member includes a head portion and a neck portion extending between the housing and the head portion. The head portion has a radial dimension from the longitudinal axis and the neck portion has a radial dimension from the longitudinal axis less than the radial dimension of the head portion. The head portion includes a plurality of radially extending spokes extending radially outward from the longitudinal axis of the housing.

Another illustrative embodiment is a system for implanting an implantable leadless cardiac pacing device. The system includes an implantable cardiac pacing device and a delivery device. The implantable cardiac pacing device has a housing, an electrode positioned proximate a distal end of the housing, and a docking member extending from a proximal end of the housing opposite the distal end. The docking member includes a head portion and a neck portion extending between the housing and the head portion. The delivery device includes an elongate shaft and a driver mechanism at a distal end of the elongate shaft. The driver mechanism is configured for engagement with the head portion of the docking member. The driver mechanism includes a first lug configured to engage a recess extending into the head portion from a proximal surface of the head portion. In some instances, the driver mechanism includes first and second spaced apart lugs configured to engage first and second portions of the recess, respectively, with a member extending across the recess positioned between the first and second lugs.

Another illustrative embodiment is a system for retrieving an implantable leadless cardiac pacing device. The system includes an implantable cardiac pacing device and a retrieval device. The implantable cardiac pacing device has a housing having a longitudinal axis, an electrode positioned proximate a distal end of the housing, and a docking member extending from a proximal end of the housing opposite the distal end. The docking member includes a head portion and a neck portion extending between the housing and the head portion. The head portion includes a plurality of radially extending spokes extending radially outward from the longitudinal axis of the housing. The retrieval device includes a snare having an elongate shaft and one or more loops at a distal end of the elongate shaft. The one or more loops of the retrieval device are capable of encircling one or more of the radially extending spokes to capture the docking member with the snare.

Another illustrative embodiment is a method of implanting an implantable cardiac pacing device. The method includes advancing an implantable cardiac pacing device into a chamber of a heart with a delivery device. The implantable cardiac pacing device includes a helical fixation mechanism extending from a distal end of a housing of the implantable cardiac pacing device and a docking member extending from a proximal end of the housing. The docking member includes a head portion and a neck portion extending between the housing and the head portion. The method further includes rotating an elongate shaft of the delivery device to rotate the helical fixation mechanism into cardiac tissue. The delivery device includes a driver mechanism at a distal end of the elongate shaft. The driver mechanism includes a first lug engaged in a recess of the head portion

of the docking member to transfer rotational motion from the driver mechanism to the implantable cardiac pacing device.

Yet another illustrative embodiment is a method of retrieving an implantable cardiac pacing device from a heart. The implantable cardiac pacing device has a housing having a longitudinal axis, an electrode positioned proximate a distal end of the housing, and a docking member extending from a proximal end of the housing opposite the distal end. The docking member includes a head portion and a neck portion extending between the housing and the head portion. The head portion includes a plurality of radially extending spokes extending radially outward from the longitudinal axis of the housing. The method includes advancing a snare into a heart having the implantable cardiac pacing device implanted therein and encircling the docking member with a loop of the snare. The loop is then cinched around a portion of the docking member and the snare is actuated proximally to pull the implantable cardiac pacing device into a lumen of a retrieval catheter.

The above summary of some example embodiments is not intended to describe each disclosed embodiment or every implementation of the aspects of the disclosure.

## BRIEF DESCRIPTION OF THE DRAWINGS

The aspects of the disclosure may be more completely understood in consideration of the following detailed description of various embodiments in connection with the accompanying drawings, in which:

FIG. **1** illustrates an exemplary implantable device implanted in a chamber of a heart;

FIG. **2** illustrates an exemplary retrieval device capturing an implantable device during a retrieval procedure;

FIG. **3** illustrates another exemplary retrieval device capturing an implantable device during a retrieval procedure;

FIGS. **4**A-**4**C illustrate an exemplary docking member of an implantable device;

FIGS. **5**A-**5**C illustrate another exemplary docking member of an implantable device;

FIGS. **6**A-**6**C illustrate another exemplary docking member of an implantable device;

FIGS. **7**A-**7**C illustrate another exemplary docking member of an implantable device;

FIGS. **8**A-**8**C illustrate another exemplary docking member of an implantable device;

FIGS. **9**A-**9**C illustrate another exemplary docking member of an implantable device;

FIGS. **10**A-**10**C illustrate another exemplary docking member of an implantable device;

FIGS. **11**A-**11**C illustrate another exemplary docking member of an implantable device;

FIGS. **12**A-**12**C illustrate another exemplary docking member of an implantable device;

FIGS. **13**A-**13**C illustrate another exemplary docking member of an implantable device;

FIGS. **14**A-**14**C illustrate another exemplary docking member of an implantable device;

FIGS. **15**A-**15**C illustrate another exemplary docking member of an implantable device;

FIGS. **16**A-**16**C illustrate another exemplary docking member of an implantable device;

FIG. **17**A illustrates an exemplary delivery device for delivering an implantable device;

FIG. **17**B illustrates the delivery device of FIG. **17**A in engagement with the docking member of the implantable device of FIGS. **15**A-**15**C;

FIG. **17**C illustrates the delivery device of FIG. **17**A in engagement with the docking member of the implantable device of FIGS. **16**A-**16**C; and

FIGS. **18**A-**18**D illustrate alternative embodiments of a driver mechanism for a rotational driving instrument.

While the aspects of the disclosure are amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit aspects of the disclosure to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the disclosure.

## DETAILED DESCRIPTION

For the following defined terms, these definitions shall be applied, unless a different definition is given in the claims or elsewhere in this specification.

All numeric values are herein assumed to be modified by the term "about", whether or not explicitly indicated. The term "about" generally refers to a range of numbers that one of skill in the art would consider equivalent to the recited value (i.e., having the same function or result). In many instances, the term "about" may be indicative as including numbers that are rounded to the nearest significant figure.

The recitation of numerical ranges by endpoints includes all numbers within that range (e.g., 1 to 5 includes 1, 1.5, 2, 2.75, 3, 3.80, 4, and 5).

Although some suitable dimensions, ranges and/or values pertaining to various components, features and/or specifications are disclosed, one of skill in the art, incited by the present disclosure, would understand desired dimensions, ranges and/or values may deviate from those expressly disclosed.

As used in this specification and the appended claims, the singular forms "a", "an", and "the" include plural referents unless the content clearly dictates otherwise. As used in this specification and the appended claims, the term "or" is generally employed in its sense including "and/or" unless the content clearly dictates otherwise.

The following detailed description should be read with reference to the drawings in which similar elements in different drawings are numbered the same. The detailed description and the drawings, which are not necessarily to scale, depict illustrative embodiments and are not intended to limit the scope of the disclosure. The illustrative embodiments depicted are intended only as exemplary. Selected features of any illustrative embodiment may be incorporated into an additional embodiment unless clearly stated to the contrary.

Referring to FIG. **1**, an exemplary implantable leadless cardiac pacing device **10** (e.g., a leadless pacemaker) is illustrated implanted in a chamber of a heart H, such as the apex of the right ventricle RV. The implantable device **10** may include a shell or housing **12** having a proximal end **14** and a distal end **16**. The implantable device **10** may include a first electrode **20** positioned proximate the distal end **16** of the housing **12** and a second electrode **22** positioned proximate the proximal end **14** of the housing **12**. The electrodes **20**, **22** may be sensing and/or pacing electrodes to provide electro-therapy and/or sensing capabilities. The first electrode **20** may be configured to be positioned against or otherwise contact the cardiac tissue of the heart H while the second electrode **22** may be spaced away from the first electrode **20**, and thus spaced away from the cardiac tissue.

The implantable device **10** may include a pulse generator (e.g., electrical circuitry) and a power source (e.g., a battery) within the housing **12** to provide electrical signals to the electrodes **20**, **22** and thus control the pacing/sensing electrodes **20**, **22**. Electrical communication between pulse generator and the electrodes **20**, **22** may provide electrical stimulation to heart tissue and/or sense a physiological condition.

The implantable device **10** may include a fixation mechanism **24** proximate the distal end **16** of the housing **12** configured to attach the implantable device **10** to a tissue wall of the heart H, or otherwise anchor the implantable device **10** to the anatomy of the patient. As shown in FIG. **1**, in some instances, the fixation mechanism **24** may include one or more, or a plurality of hooks **26** anchored into the cardiac tissue of the heart H to attach the implantable device **10** to a tissue wall. In other instances, the fixation mechanism **24** may include one or more, or a plurality of passive tines, configured to entangle with trabeculae within the chamber of the heart H and/or a helical fixation anchor configured to be screwed into a tissue wall to anchor the implantable device **10** to the heart H.

The implantable device **10** may include a docking member **30** proximate the proximal end **14** of the housing **12** configured to facilitate delivery and/or retrieval of the implantable device **10**. For example, the docking member **30** may extend from the proximal end **14** of the housing **12** along a longitudinal axis of the housing **12**. The docking member **30** may include a head portion **32** and a neck portion **34** extending between the housing **12** and the head portion **32**. The head portion **32** may be an enlarged portion relative to the neck portion **34**. For example, the head portion **32** may have a radial dimension from the longitudinal axis of the implantable device **10** which is greater than a radial dimension of the neck portion from the longitudinal axis of the implantable device **10**. The docking member **30** may be configured to facilitate delivery of the implantable device **10** to the intracardiac site and/or retrieval of the implantable device **10** from the intracardiac site. Some exemplary embodiments of the docking member **30** are described in further detail herein.

If it is desired to retrieve the implantable device **10** from the heart H, a retrieval device **50** may be advanced into the chamber of the heart H to capture the implantable device **10** and remove the implantable device **10** from the heart H. One exemplary retrieval device **50** is illustrated in FIG. **2**. The retrieval device **50** may include a snare **52** advanceable from a lumen **58** of a retrieval catheter **54**. The snare **52** may include one or more, or a plurality of loops **56** extending from a distal end of the snare **52** configured to engage the docking member **30** of the implantable device **10**. The snare **52** shown in FIG. **2** includes three loops **56** formed by elongate filaments extending from the shaft of the snare **52**. Once the loop(s) **56** of the snare **52** has captured the docking member **30**, the snare **52** may be actuated proximally relative to the retrieval catheter **54** to pull the implantable device **10** into the lumen **58** of the retrieval catheter **54**. The enlarged size of the head portion **32** relative to the neck portion **34** may permit the loop **56** of the snare **52** to encircle the neck portion **34** below (i.e., distal of) the head portion **32** and retain the loop **56** around the docking member **30** as the snare **52** is pulled proximally. As the implantable device **10** is pulled into the retrieval catheter **54**, the fixation mechanism **24** may disengage from the heart tissue to detach the implantable device **10** from the heart wall. For example, the hooks **26** may elongate as the implantable device **10** is drawn proximally into the lumen **58** of the retrieval catheter **54**. Thereafter, the retrieval device **50**, with the implantable device **10** captured in the lumen of the retrieval catheter **54** with the snare **52**, may be withdrawn from the heart H.

Another exemplary retrieval device **50** is illustrated in FIG. **3**. Similar to FIG. **2**, the retrieval device **50** may include a snare **52** advanceable from a lumen **58** of a retrieval catheter **54**. The snare **52** may include one or more, or a plurality of loops **56** extending from a distal end of the snare **52** configured to engage the docking member **30** of the implantable device **10**. The snare **52** shown in FIG. **3** includes a single loop **56** formed by an elongate filament extending from the shaft of the snare **52**. Once the loop **56** of the snare **52** has captured the docking member **30**, the snare **52** may be actuated proximally relative to the retrieval catheter **54** to pull the implantable device **10** into the lumen **58** of the retrieval catheter **54**. The enlarged size of the head portion **32** relative to the neck portion **34** may permit the loop **56** of the snare **52** to encircle the neck portion **34** below (i.e., distal of) the head portion **32** and retain the loop **56** around the docking member **30** as the snare **52** is pulled proximally. As the implantable device **10** is pulled into the retrieval catheter **54**, the fixation mechanism **30** may disengage from the heart tissue to detach the implantable device **10** from the heart wall. For example, the hooks **26** may elongate as the implantable device **10** is drawn proximally into the lumen **58** of the retrieval catheter **54**. Thereafter, the retrieval device **50**, with the implantable device **10** captured in the lumen of the retrieval catheter **54** with the snare **52**, may be withdrawn from the heart H.

FIGS. **4A-4C** illustrate one exemplary docking member **30** located at the proximal end **14** of the implantable device **10**. The docking member **30** shown in FIGS. **4A-4C** may include a head portion **32** and a neck portion **34** extending between the housing **12** and the head portion **32**. The head portion **32** may be a generally spherically shaped ball, having a diameter D**1** greater than the diameter D**2** of the neck portion **34**. The docking member **30** may also include a passage **36** extending through a portion of the docking member **30** to receive a tether **80** (shown in phantom lines) which will be further described later herein. For example, the passage **36** may extend through the head portion **32** from a first side to a second side of the head portion **32**. The spherical shape of the head portion **32** may provide an atraumatic profile, inhibiting tissue growth or entanglement around the docking member **30**.

FIGS. **5A-5C** illustrate another exemplary docking member **30** located at the proximal end **14** of the implantable device **10**. The docking member **30** shown in FIGS. **5A-5C** may include a head portion **32** and a neck portion **34** extending between the housing **12** and the head portion **32**. The head portion **32** may be a generally disc shaped element having an upper surface **62** and an opposing lower surface **64**. In some instances, the upper surface **62** and/or the lower surface **64** may be a spherically convex surface while in other instances the upper surface **62** and/or the lower surface **64** may be a spherically concave surface or a planar surface, for example. The head portion **32** may have a diameter D**1** greater than the diameter D**2** of the neck portion **34**. Although not shown, the docking member **30** may also include a passage extending through a portion of the docking member **30** to receive a tether (described later herein). For example, a passage may extend through the head portion **32** from a first side to a second side of the head portion **32**, or a passage may extend through the neck portion **34** from a first side to a second side of the neck portion **34**. The shape of the head portion **32** may provide an atraumatic profile, inhibiting tissue growth or entanglement around the docking member **30**.

FIGS. **6**A-**6**C illustrate another exemplary docking member **30** located at the proximal end **14** of the implantable device **10**. The docking member **30** shown in FIGS. **6**A-**6**C may include a head portion **32** and a neck portion **34** extending between the housing **12** and the head portion **32**. The head portion **32** may be generally knob shaped, having a diameter D**1** greater than the diameter D**2** of the neck portion **34**. The docking member **30** may also include a passage **36** extending through a portion of the docking member **30** to receive a tether **80** (shown in phantom) further described later herein. For example, the head portion **32** may include a central opening **66** extending into the head portion **32**. A pin **68** may extend into or across the opening **66**. For example, as shown in FIG. **6**C the pin **68** may extend from a first side to a second side of the opening **66**. In other instances, the pin **68** may extend into the opening **66** from a first side toward a second side of the opening **66**, but not entirely across the opening **66** to the second side. The passage **36** may extend under the pin **68** such that the tether may be passed around the pin **68**. The shape of the head portion **32** may provide an atraumatic profile, inhibiting tissue growth or entanglement around the docking member **30**.

FIGS. **7**A-**7**C illustrate another exemplary docking member **30** located at the proximal end **14** of the implantable device **10**. The docking member **30** shown in FIGS. **7**A-**7**C may include a head portion **32** and a neck portion **34** extending between the housing **12** and the head portion **32**. The head portion **32** may include a plurality of enlarged portions **70** spaced apart by a reduced diameter necked portion **72**. In some instances, the enlarged portions **70** may be generally knob shaped, having a diameter D**1** greater than the diameter D**3** of the necked portion between the enlarged portions **70** and the diameter D**2** of the neck portion **34**. Multiple enlarged portions **70** may facilitate engaging the docking member **30** with the loop(s) **56** of the snare **52** during retrieval of the implantable device **10**. The shape of the head portion **32** may provide an atraumatic profile, inhibiting tissue growth or entanglement around the docking member **30**.

The docking member **30** may also include a passage **36** extending through a portion of the docking member **30** to receive a tether (described later herein). For example, the head portion **32** may include a central opening **66** extending into the head portion **32**. A pin **68** may extend into or across the opening **66**. For example, as shown in FIG. **7**C the pin **68** may extend from a first side to a second side of the opening **66**. In other instances, the pin **68** may extend into the opening **66** from a first side toward a second side of the opening **66**, but not entirely across the opening **66** to the second side. The passage **36** may extend under the pin **68** such that the tether may be passed around the pin **68**.

FIGS. **8**A-**8**C illustrate another exemplary docking member **30** located at the proximal end **14** of the implantable device **10**. The docking member **30** shown in FIGS. **8**A-**8**C may include a head portion **32** and a neck portion **34** extending between the housing **12** and the head portion **32**. The head portion **32** may have a diameter D**1** greater than the diameter D**2** of the neck portion **34**. The head portion **32** may include a plurality of spokes **70** extending radially from the longitudinal axis of the implantable device **10**, with spaces defined between adjacent spokes **70**. The spokes **70** may be symmetrically or asymmetrically arranged around the longitudinal axis X. For example, the head portion **32** may include four spokes **70** uniformly arranged around the longitudinal axis X about 90 degrees apart. As shown in FIG. **8**X, the free ends **72** of the radially extending spokes **70** may angle (e.g., curve) toward the distal end **16** of the implantable device **10**, in some instances. For example, an upper surface **74** and/or a lower surface **76** of the spokes **70** may extend at an oblique angle to the longitudinal axis X of the implantable device **10** toward the distal end **16**, such that the free ends **72** of the spokes **70** are positioned closer to the distal end **16** of the implantable device **10** than the base portion of the spokes **70** proximate the central longitudinal axis X. The configuration and/or arrangement of the spokes **70** may facilitate retention of the loop **56** of the snare **52** in engagement of the docking member **30** during retrieval of the implantable device **10**. For example, the loop **56** may encircle one or more of the spokes **70** in addition to or instead of the neck portion **34**.

Although not shown, the docking member **30** may also include a passage extending through a portion of the docking member **30** to receive a tether (described later herein). For example, a passage may extend through the one or more of the spokes **70** from a first side to a second side of the spoke **70**, or a passage may extend through the neck portion **34** from a first side to a second side of the neck portion **34**.

FIGS. **9**A-**9**C illustrate another exemplary docking member **30** located at the proximal end **14** of the implantable device **10**, similar to the docking member **30** illustrated in FIGS. **8**A-**8**C. The docking member **30** shown in FIGS. **9**A-**9**C may similarly include a plurality of spokes **70** extending radially from the longitudinal axis of the implantable device **10**, with spaces defined between adjacent spokes **70**, except the spokes **70** shown in FIGS. **9**A-**9**C may have a width W less than the width of the spokes shown in FIGS. **8**A-**8**C.

Although not shown, the docking member **30** may also include a passage extending through a portion of the docking member **30** to receive a tether (described later herein). For example, a passage may extend through the one or more of the spokes **70** from a first side to a second side of the spoke **70**, or a passage may extend through the neck portion **34** from a first side to a second side of the neck portion **34**.

FIGS. **10**A-**10**C illustrate another exemplary docking member **30** located at the proximal end **14** of the implantable device **10**, similar to the docking member **30** illustrated in FIGS. **8**A-**8**C. The docking member **30** shown in FIGS. **10**A-**10**C may similarly include a plurality of spokes **70** extending radially from the longitudinal axis of the implantable device **10**, with spaces defined between adjacent spokes **70**. The width W of the spokes **70** shown in FIGS. **10**A-**10**C may increase from the base portion toward the free ends **72** of the spokes. Thus, in instances in which the loop **56** of the snare **52** encircles one or more of the spokes **70**, the enlarged free end **72** of the spokes **70** may prevent the loop **56** of the snare **52** from slipping off the spoke(s) **70** during retrieval of the implantable device **10**.

Although not shown, the docking member **30** may also include a passage extending through a portion of the docking member **30** to receive a tether (described later herein). For example, a passage may extend through the one or more of the spokes **70** from a first side to a second side of the spoke **70**, or a passage may extend through the neck portion **34** from a first side to a second side of the neck portion **34**.

FIGS. **11**A-**11**C illustrate another exemplary docking member **30** located at the proximal end **14** of the implantable device **10**, similar to the docking member **30** illustrated in FIGS. **8**A-**8**C. The docking member **30** shown in FIGS. **11**A-**11**C may include a pair of spokes **70** extending radially from the longitudinal axis of the implantable device **10** in opposite directions. Similar to the spokes **70** shown in FIGS. **10**A-**10**C, the width W of the spokes **70** shown in FIGS. **11**A-**11**C may increase from the base portion toward the free ends **72** of the spokes. Thus, in instances in which the loop **56** of the snare **52** encircles one or more of the spokes **70**, the enlarged free end **72** of the spokes **70** may prevent the loop **56** of the snare **52** from slipping off the spoke(s) **70** during retrieval of the implantable device **10**.

Although not shown, the docking member **30** may also include a passage extending through a portion of the docking member **30** to receive a tether (described later herein). For example, a passage may extend through the one or more of the spokes **70** from a first side to a second side of the spoke **70**, or a passage may extend through the neck portion **34** from a first side to a second side of the neck portion **34**.

FIGS. **12**A-**12**C illustrate another exemplary docking member **30** located at the proximal end **14** of the implantable device **10**, similar to the docking member **30** illustrated in FIGS. **11**A-**11**C. The docking member **30** shown in FIGS. **12**A-**12**C may include a pair of spokes **70** extending radially from the longitudinal axis of the implantable device **10** in opposite directions. The free ends **72** of the spokes **70** may include a crossing member **74** extending transverse to the radial direction of the spokes **70**. In some instances, the crossing member **74** may extend in opposite directions from the body of the spoke **70**, or the crossing member **74** may extend in one transverse direction from the body of the spoke **70**. For example, in some instances, the spokes **70** may have a T shape, a mushroom shape, an L shape, a V shape, or other desired shape. In some instances, the crossing member **74** may form an undercut **76** with the body of the spoke **70**. The loop **56** of the snare **52** may be engaged in the undercuts **76** as the loop **56** is tightened around the spoke **70**. In instances in which the loop **56** of the snare **52** encircles one or more of the spokes **70**, the crossing member **74** at the free end **72** of the spokes **70** may prevent the loop **56** of the snare **52** from slipping off the spoke(s) **70** during retrieval of the implantable device **10**.

Although not shown, the docking member **30** may also include a passage extending through a portion of the docking member **30** to receive a tether (described later herein). For example, a passage may extend through the one or more of the spokes **70** from a first side to a second side of the spoke **70**, or a passage may extend through the neck portion **34** from a first side to a second side of the neck portion **34**.

FIGS. **13**A-**13**C illustrate another exemplary docking member **30** located at the proximal end **14** of the implantable device **10**, similar to the docking member **30** illustrated in FIGS. **12**A-**12**C. The docking member **30** shown in FIGS. **13**A-**13**C may include a plurality of spokes **70** extending radially from the longitudinal axis of the implantable device **10**, with spaces defined between adjacent spokes **70**. The spokes **70** may be symmetrically or asymmetrically arranged around the longitudinal axis. For example, the head portion **32** may include three spokes **70** uniformly arranged around the longitudinal axis about 120 degrees apart. Similar to the spokes illustrated in FIGS. **12**A-**12**C, the free ends **72** of the spokes **70** may include a crossing member **74** extending transverse to the radial direction of the spokes **70**. In some instances, the crossing member **74** may extend in opposite directions from the body of the spoke **70**, or the crossing member **74** may extend in one transverse direction from the body of the spoke **70**. For example, in some instances, the spokes **70** may have a T shape, a mushroom shape, an L shape, a V shape, or other desired shape. In some instances, the crossing member **74** may form an undercut **76** with the body of the spoke **70**. The loop **56** of the snare **52** may be engaged in the undercuts **76** as the loop **56** is tightened around the spoke **70**. In instances in which the loop **56** of the snare **52** encircles one or more of the spokes **70**, the crossing member **74** at the free end **72** of the spokes **70** may prevent the loop **56** of the snare **52** from slipping off the spoke(s) **70** during retrieval of the implantable device **10**.

Although not shown, the docking member **30** may also include a passage extending through a portion of the docking member **30** to receive a tether (described later herein). For example, a passage may extend through the one or more of the spokes **70** from a first side to a second side of the spoke **70**, or a passage may extend through the neck portion **34** from a first side to a second side of the neck portion **34**.

FIGS. **14**A-**14**C illustrate another exemplary docking member **30** located at the proximal end **14** of the implantable device **10**, similar to the docking member **30** illustrated in FIGS. **8**A-**8**C. The docking member **30** shown in FIGS. **14**A-**14**C may similarly include a plurality of spokes **70** extending radially from the longitudinal axis of the implantable device **10**, with spaces defined between adjacent spokes **70**. The docking member **30** may include any number of radially extending spokes **70** symmetrically or asymmetrically arranged around the longitudinal axis of the implantable device **10**. For example, the docking member **30** may include 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 or more radially extending spokes **70** in some instances.

As shown in FIG. **14**C, the free ends **72** of the spokes **70** may include a distally projecting lip **78** relative to the body portion of the spokes **70**. The distally projecting lips **78** may prevent the loop **56** of the snare **52** from slipping off the spoke(s) **70** during retrieval of the implantable device **10**.

The configuration and/or arrangement of the spokes **70** may facilitate retention of the loop **56** of the snare **52** in engagement of the docking member **30** during retrieval of the implantable device **10**. For example, the loop **56** may encircle one or more of the spokes **70** in addition to or instead of the neck portion **34**.

In some instances it may be desirable to apply rotational motion to the implantable device **10** during delivery and/or retrieval of the implantable device **10**. For example, in some embodiments such as the embodiment shown in FIG. **15**A, the implantable device **10** may include a helical fixation anchor **90** at the distal end **16** of the housing **12** configured to be screwed into a tissue wall through rotational motion of the implantable device **10** to anchor the implantable device **10** to the heart H. In such instances, the docking member **30** may include an engagement feature configured to mate with an engagement feature of a delivery device to transfer rotational motion from a rotatable shaft of the delivery device to the implantable device **10**.

For example, in the embodiment of FIGS. **15**A-**15**C, the implantable device **10** may include a docking member **30** extending from the proximal end **14** of the housing **12** along a longitudinal axis of the housing **12**. The docking member **30** may include a head portion **32** and a neck portion **34** extending between the housing **12** and the head portion **32**. The head portion **32** may be an enlarged portion relative to the neck portion **34**. For example, the head portion **32** may have a radial dimension from the longitudinal axis of the implantable device **10** which is greater than a radial dimension of the neck portion from the longitudinal axis of the implantable device **10**.

The head portion **32** may include a recess **82** extending into the head portion **32** from a proximal surface **84** of the head portion **32**. The recess **82** may be configured to receive a rotational driving instrument therein. For example, the recess **82** may be configured to receive a distal driver mechanism of a rotational driving instrument therein. In some instances, the recess **82** may extend generally perpendicular to the longitudinal axis of the housing **12**. In some embodiments, the recess **82** may extend across the head portion **32** from a first side of the head portion **32** to a second side of the head portion **32**. As shown in FIG. **15**C, the head portion **32** may include a distal surface **85** opposite the proximal surface **84** from which the neck portion **34** extends from. In some instances, the recess **82** may extend into the head portion **32** from the proximal surface **84** toward the distal surface **85**, but does not extend to the distal surface **85**. However, in other embodiments the recess **82** may extend to the distal surface **85**.

The head portion **32** may also include a member **86** extending across the recess **82** dividing the recess **82** into a first recess portion **82***a* on a first side of the member **86** and a second recess portion **82***b* on a second side of the member **86**. In some instances, the member **86** may extend generally perpendicular to the recess **82** and/or the longitudinal axis of the housing **12**. As shown in FIGS. **15**A-**15**C, in some instances the member **86** may be formed as a monolithic portion of the head portion **32** bridging across the recess **82**. In other embodiments, however, the member **86** may be a separate component attached to the head portion **32**.

A tether **80** may extend through a passage beneath the member **86** defined by the recess **82** during delivery of the implantable device **10**. For example, the tether **80** may be attached to the member **86** and extend proximally from the member **86** along an elongate shaft of a delivery device to a location accessible by a physician during implantation of the implantable device **10**. Once the implantable device **10** has been properly implanted in the heart H, the tether **80** may be detached from the member **86** and withdrawn from the patient.

FIGS. **16**A-**16**C illustrate another implantable device **10** including a helical fixation anchor **90** at the distal end **16** of the housing **12** configured to be screwed into a tissue wall through rotational motion of the implantable device **10** to anchor the implantable device **10** to the heart H. Similar to the embodiment of FIGS. **15**A-**15**C, the docking member **30** may include an engagement feature configured to mate with an engagement feature of a delivery device to transfer rotational motion from a rotatable shaft of the delivery device to the implantable device **10**.

For example, in the embodiment of FIGS. **16**A-**16**C, the implantable device **10** may include a docking member **30** extending from the proximal end **14** of the housing **12** along a longitudinal axis of the housing **12**. The docking member **30** may include a head portion **32** and a neck portion **34** extending between the housing **12** and the head portion **32**. The head portion **32** may be an enlarged portion relative to the neck portion **34**. For example, the head portion **32** may have a radial dimension from the longitudinal axis of the implantable device **10** which is greater than a radial dimension of the neck portion from the longitudinal axis of the implantable device **10**.

The head portion **32** may include a recess **82** extending into the head portion **32** from a proximal surface **84** of the head portion **32**. The recess **82** may be configured to receive a rotational driving instrument therein. For example, the recess **82** may be configured to receive a distal driver mechanism of a rotational driving instrument therein. In some instances, the recess **82** may extend generally perpendicular to the longitudinal axis of the housing **12**. In some embodiments, the recess **82** may extend across the head portion **32** from a first side of the head portion **32** to a second side of the head portion **32**. As shown in FIG. **16**C, the head portion **32** may include a distal surface **85** opposite the proximal surface **84** from which the neck portion **34** extends from. In some instances, the recess **82** may extend into the head portion **32** from the proximal surface **84** toward the distal surface **85**, but does not extend to the distal surface **85**. However, in other embodiments the recess **82** may extend to the distal surface **85**.

The head portion **32** may also include a member extending across the recess **82** dividing the recess **82** into a first recess portion **82***a* on a first side of the member and a second recess portion **82***b* on a second side of the member. As shown in FIGS. **16**A-**16**C, the member may be a pin **88** extending across the recess **82** or bridging across the recess **82**. In some instances, the pin **88** may extend generally perpendicular to the recess **82** and/or the longitudinal axis of the housing **12**. The pin **88** may be inserted through a hole **89** in the head portion **32** to position the pin **88** across the recess **82**, for example.

A tether **80** may extend through a passage beneath the pin **88** defined by the recess **82** during delivery of the implantable device **10**. For example, the tether **80** may be attached to the pin **88** and extend proximally from the pin **88** along an elongate shaft of a delivery device to a location accessible by a physician during implantation of the implantable device **10**. Once the implantable device **10** has been properly implanted in the heart H, the tether **80** may be detached from the pin **88** and withdrawn from the patient.

It is noted that in other embodiments the tether **80** may be attached to the docking member **30** (such as through a passage in the docking member **30**) and extend proximally from the docking member **30** along an elongate shaft of a delivery device to a location accessible by a physician during implantation of the implantable device **10**. Similarly, once the implantable device **10** has been properly implanted in the heart H, the tether **80** may be detached from the docking member **30** and withdrawn from the patient.

An exemplary delivery device **100** including a rotational driving instrument **102** and a delivery sheath **104** is illustrated in FIG. **17**A. The rotational driving instrument **102** may include an elongate drive shaft **106** and a driver mechanism **108** at the distal end of the elongate drive shaft **106**. The driver mechanism **108** may be configured for engagement with the head portion **32** of the docking member **30** to transfer rotational and/or longitudinal movement therebetween. The rotational driving instrument **102** may extend through a lumen **110** of the delivery sheath **104**. The driving instrument **102** may be rotatable and longitudinally movable relative to the delivery sheath **104**. The delivery sheath **104** may be sized such that the implantable device **10** may be positioned in a distal region of the lumen **110**, with the driving instrument **102** engaged with a proximal portion of the implantable device **10** and extending proximally therefrom.

The driver mechanism **108** may include a pusher **112**, such as a plate, located at the distal end of the elongate shaft **106** having a distal end surface **116** configured to engage the proximal surface **84** of the docking member **30**. The driver mechanism **108** may also include one or more, or a plurality of protuberances, such as lugs **114**, extending distally from the distal end surface **116** of the pusher **112**, or otherwise arranged. For example, the driver mechanism **108** shown in FIG. **17**A includes a first lug **114** and a second lug **114** spaced from the first lug **114** and extending in a distal direction from the distal end surface **116** of the pusher **112**. The lug(s) **114** may be configured to engage in the recess **82** of the head portion **32** of the docking member **30**.

The rotational driving instrument **102** may also include a lumen **118** extending therethrough. For example, the lumen **118** may extend through the elongate shaft **106** to an opening in the distal end surface **116** of the pusher **112** of the driver mechanism **108**. The lumen **118** may be configured to receive the tether **80** therethrough such that the tether **80** may extend along the delivery device **100** to a proximal region of the delivery device **100** through the driving instrument **102**. In other instances, the tether **80** may extend along the delivery device **100** through the lumen **110** of the delivery sheath **104** and external of the driving instrument **102**, for example.

FIG. **17**B illustrates an exemplary interaction between the delivery device **100** and the implantable device **10** with the docking member **30** shown in FIGS. **15**A-**15**C during delivery and implantation of the implantable device **10** in a heart H, or other desired anatomy. As shown in FIG. **17**B, the implantable device **10** may be positioned in the lumen **110** of the delivery sheath **104** with the driving instrument **102** engaged with the docking member **30**. For instance, the distal end surface **116** of the pusher **112** may abut the proximal surface **84** of the head portion **32** of the docking member **30** while the first lug **114** is positioned in the first recess portion **82***a* on a first side of the member **86** and the second lug **114** is positioned in the second recess portion **82***b* on a second side of the member **86**.

Accordingly, with the driver mechanism **108** engaged to the docking member **30**, rotational movement of the driving instrument **102** may be transferred to the implantable device **10** to screw the helical fixation anchor **90** into a tissue wall and/or unscrew the helical fixation anchor **90** from a tissue wall.

FIG. **17**C illustrates an exemplary interaction between the delivery device **100** and the implantable device **10** with the docking member **30** shown in FIGS. **16**A-**16**C during delivery and implantation of the implantable device **10** in a heart H, or other desired anatomy. In many respects the interaction may be similar to that described above regarding FIG. **17**B. However, in FIG. **17**C, the member extending across the recess **82** is shown as a pin **88**. Accordingly, when the driver mechanism **108** is engaged to the docking member **30**, the distal end surface **116** of the pusher **112** may abut the proximal surface **84** of the head portion **32** of the docking member **30** while the first lug **114** is positioned in the first recess portion **82***a* on a first side of the pin **88** and the second lug **114** is positioned in the second recess portion **82***b* on a second side of the pin **88**.

Accordingly, with the driver mechanism **108** engaged to the docking member **30**, rotational movement of the driving instrument **102** may be transferred to the implantable device **10** to screw the helical fixation anchor **90** into a tissue wall and/or unscrew the helical fixation anchor **90** from a tissue wall.

FIGS. **18**A-**18**D illustrate alternative embodiments of a driver mechanism **108** for a rotational driving instrument **102** configured to mate with a docking member of an implantable device, such as one or more of the docking members **30** of the implantable device **10**, described herein.

The driver mechanism **108** shown in FIGS. **18**A-**18**C may be similar to the driver mechanism **108** shown in FIGS. **17**A-**17**C. For example, the rotational driving instrument **102** may include an elongate drive shaft **106** and a driver mechanism **108** at the distal end of the elongate drive shaft **106**. The driver mechanism **108** may be configured for engagement with the head portion **32** of the docking member **30** to transfer rotational and/or longitudinal movement therebetween. The rotational driving instrument **102** may extend through a lumen **110** of the delivery sheath **104** (shown in FIG. **17**A).

The driver mechanism **108** may include a pusher **112** having a distal end surface **116** configured to engage the proximal surface **84** of the docking member **30** and one or more, or a plurality of protuberances, such as lugs **114**, extending distally from the distal end surface **116** of the pusher **112**. For example, the driver mechanism **108** shown in FIG. **18**A includes four equally spaced apart lugs **114**, the driver mechanism **108** shown in FIG. **18**B includes three equally spaced apart lugs **114**, and the driver mechanism **108** shown in FIG. **18**C includes four equally spaced apart lugs **114** extending in a distal direction from the distal end surface **116** of the pusher **112**. The lug(s) **114** may be configured to extend into openings between adjacent spokes **70** of the docking members **30** described herein, and engage in the spokes **70** of the head portion **32** of the docking member **30** to transfer rotational torque therebetween.

The rotational driving instrument **102** may also include a lumen **118** extending through the elongate shaft **106** configured to receive the tether **80** therethrough such that the tether **80** may extend along the delivery device **100** to a proximal region of the delivery device **100** through the driving instrument **102**. In other instances, the tether **80** may extend along the delivery device **100** through the lumen **110** of the delivery sheath **104** and external of the driving instrument **102**, for example.

The shape, size, quantity and arrangement of the lugs **114** may be chosen to complement and mate with the shape, size, quantity and arrangement of spokes **70** of the docking member **30**. For example, the lugs **114** shown in FIG. **18**C, may be triangular or wedge shaped to fit between adjacent spokes **70** of the docking member **30** shown in FIG. **8**A, **9**A, **10**A or **14**A. In other instances, the shape of the lugs **114** may be chosen to complement and mate with the spokes **70** shown in FIG. **11**A, **12**A or **13**A, for example.

In other instances, as shown in FIG. **18**D, the driver mechanism **108** of the rotational driving instrument **102** may include a socket **120** shaped, sized and configured to mate with the head portion **32** of the docking member **30** to transfer rotational torque therebetween. For example, as shown in FIG. **18**D, the socket **120** may include opposing arcuate edges and opposing flat edges extending between the arcuate edges, configured to complement the shape and size of the docking member **30** shown in FIG. **4**A. The flat edges of the socket **120** may engage the flat sides of the docking member **30** to transfer rotational torque therebetween. It is noted that in some instances, the socket **120** may include a single flat side for engagement with a flat side of the docking member **30**.

In other instances, the socket **120** may have another shape, size and configuration to mate with the head portion **32** of another docking member **30**. For example, the socket **120** may include a complementary shape, size and configuration to the head portion **32** of the docking member **30** shown in FIG. **8**A, **9**A, **10**A, **11**A, **12**A, **13**A or **14**A such that the head portion **32** of the docking member **30** fits into the socket **120**. The socket **120** may include at least one edge or surface configured to engage a surface of the head portion **32** of the docking member **30** to transfer rotational torque therebetween.

Those skilled in the art will recognize that aspects of the present disclosure may be manifested in a variety of forms other than the specific embodiments described and contemplated herein. Accordingly, departure in form and detail may be made without departing from the scope and spirit of the present disclosure as described in the appended claims.

What is claimed is:

**1**. An implantable leadless cardiac pacing device comprising:

a housing having a proximal end and a distal end;

an electrode positioned proximate the distal end of the housing configured to be positioned adjacent cardiac tissue; and

a docking member extending from the proximal end of the housing along a longitudinal axis of the housing, the docking member configured to facilitate retrieval of the implantable leadless cardiac pacing device;

the docking member including a head portion and a neck portion extending between the housing and the head portion;

the head portion having a radial dimension from the longitudinal axis and the neck portion having a radial dimension from the longitudinal axis less than the radial dimension of the head portion;

the head portion including a plurality of radially extending spokes extending radially outward from the longitudinal axis of the housing;

wherein each spoke includes a base portion proximate the longitudinal axis of the housing and a free end extending radially outward from the base portion, wherein a width of each spoke increases from the base portion toward the free end of the spoke.

**2**. The implantable leadless cardiac pacing device of claim **1**, wherein each of the spokes extends at an oblique angle to the longitudinal axis of the housing toward the distal end such that the free ends of the plurality of spokes are positioned closer to the distal end of the housing than the base portion of the spokes proximate the longitudinal axis of the housing.

**3**. The implantable leadless cardiac pacing device of claim **1**, wherein the plurality of spokes are configured to mate with an engagement mechanism of a rotational driving instrument to transfer rotational torque to the implantable leadless cardiac pacing device.

**4**. An implantable leadless cardiac pacing device comprising:

a housing having a proximal end and a distal end;

an electrode positioned proximate the distal end of the housing configured to be positioned adjacent cardiac tissue; and

a docking member extending from the proximal end of the housing along a longitudinal axis of the housing, the docking member configured to facilitate retrieval of the implantable leadless cardiac pacing device;

the docking member including a head portion and a neck portion extending between the housing and the head portion;

the head portion having a radial dimension from the longitudinal axis and the neck portion having a radial dimension from the longitudinal axis less than the radial dimension of the head portion;

the head portion including a plurality of radially extending spokes extending radially outward from the longitudinal axis of the housing;

wherein each of the spokes includes a body portion extending radially outward to a free end of the spoke and a crossing member extending transverse to the body portion.

**5**. The implantable leadless cardiac pacing device of claim **4**, wherein the crossing member extends in opposite directions from the body portion.

**6**. The implantable leadless cardiac pacing device of claim **5**, wherein the spoke is T-shaped.

**7**. The implantable leadless cardiac pacing device of claim **5**, wherein each spoke includes undercut portions at a junction between the crossing member and the body portion of the spoke.

**8**. A system for retrieving an implantable leadless cardiac pacing device, comprising:

an implantable cardiac pacing device having a housing having a longitudinal axis, an electrode positioned proximate a distal end of the housing, and a docking member extending from a proximal end of the housing opposite the distal end, the docking member including a head portion and a neck portion extending between the housing and the head portion, the head portion including a plurality of radially extending spokes extending radially outward from the longitudinal axis of the housing; and

a retrieval device including a snare having an elongate shaft and one or more loops at a distal end of the elongate shaft;

wherein the one or more loops of the retrieval device are capable of encircling one or more of the radially extending spokes to capture the docking member with the snare;

wherein each spoke includes:

i) a base portion proximate the longitudinal axis of the housing and a free end extending radially outward from the base portion, wherein a width of each spoke increases from the base portion toward the free end of the spoke; or

ii) a body portion extending radially outward to a free end of the spoke and a crossing member extending transverse to the body portion.

**9**. The system of claim **8**, wherein if the spoke includes ii), the crossing member extends in opposite directions from the body portion.

**10**. The system of claim **9**, wherein the spoke is T-shaped.

**11**. The system of claim **9**, wherein each spoke includes undercut portions at a junction between the crossing member and the body portion of the spoke.

**12**. The system of claim **8**, wherein if the spoke includes i), each of the spokes extends at an oblique angle to the longitudinal axis of the housing toward the distal end such that the free ends of the plurality of spokes are positioned closer to the distal end of the housing than the base portion of the spokes proximate the longitudinal axis of the housing.

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